FIREWOOD DEMAND AND SUPPLY STUDY

FOR EASTMAIN,

WEMINDJI AND WASKAGANISH, QUEBEC

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FIREWOOD DEMAND AND SUPPLY STUDY

FOR EASTMAIN, WEMINDJI AND WASKAGANISH*, QUEBEC

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Grand Council of the Crees (of Quebec)
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With contributions from:

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and
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of Energy, Mines and Resources Canada

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*formerly known as Rupert House and Fort Rupert

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EXECUTIVE SUMMARY

Objectives

The Cree Regional Authority is trying to rationalize the use of firewood as an alternative source of energy for residential heating purposes in the communities of Waskaganish*, Eastmain and Wemindji.

The objective of this study is to provide the following information:

- assessment of the wood supply and wood demand in the three communities over the next thirty years;
- definition of the optimal exploitation strategies for wood;
- evaluation of the costs associated with various wood-oil utilization scenarios for residential heating purpose in order to recommend the optimal energy mix for each of the three communities.

Methodology

The maximum firewood demand is a function of the wood calorific value and the heating energy demand. The calorific value depends on the wood species and its humidity level. The heating energy demand is derived from the results of an energy audit of a representative sample of houses in the three communities. The energy audit results are then extrapolated over the next thirty years using the forecasts of the residential sector evolution.

Firewood supply is assessed through a standard and well accepted methodology used by forestry specialists. The objective is to define an area with an adequate forest potential to fulfill the heating energy needs of the residential sector of the three communities. The harvesting is planned as not to handicap the long term forest capital. Exploitation strategies are also studied in order to minimize the costs and to maximize the forest yield.

The wood supply operations are designed to be labor intensive so as to minimize the purchase of expensive equipment which would be underutilized.

A financial analysis completes the study. Seven heating scenarios including oil, wood and electricity heating are studied as to define the heating option which minimizes the cash outlays while taking into account the social impacts related to each scenario.

* Formerly known as Rupert House and Fort Rupert

The heating costs include fuel cost, purchase of heating equipment when necessary and maintenance cost. These costs are discounted to January 1st 1984, with a discount rate of 6%. This rate is expressed in real terms without inflation. All costs are in 1984 dollars.

Conclusion and recommendations

The energy audit indicates that the recent house models are energy efficient and the planned renovations should improve significantly the older houses energy consumption. The average room temperature is kept lower than the canadian average which means that people in these three communities consume less energy for a given outdoor temperature than the average Canadian. This conclusion is incorporated into the houses energy consumption evaluation.

The persons interviewed expressed their interest in having a dual energy system such as a wood-oil furnace. Wood is used to lower the heating costs and the oil furnace is used as a stand-by unit which starts working if the wood furnace is missing fuel (firewood). The manual feeding of the wood furnace is then no more considered as a problem.

The total energy demand in 1983 was 3 736 000 KWh, 1 463 000 KWh and 2 879 600 KWh for Waskaganish, Eastmain and Wemindji respectively. Energy demand projections are made for thirty years. This demand is then translated in wood demand.

This study indicates the existence of an adequate forest potential surrounding the three communities which can fulfill their heating needs for the next thirty years with acceptable ecological impacts. In Eastmain, the area including the sites where people traditionnally get firewood contains enough wood to satisfy their long term heating energy demand.

In Waskaganish and Wemindji, wood harvesting will be executed over a larger area. This is the consequence of their larger population and a weaker forest capital in the immediate surroundings. The maximum travel distance to harvest wood will be 20 km in Waskaganish and Wemindji.

The harvesting method suggested is labour intensive and uses snowmobiles and sleighs for the wood transportation. A communal approach is proposed as to ensure a controlled exploitation of the forest capital and to favour a larger utilization of wood as heating fuel.

The production cost of a large cord of wood will vary from 105$ to 125$ depending on the distance between the harvesting site and the community.

The present worth of the heating costs when only oil, wood or electricity is used are presented below:

TABLE I

PRESENT VALUES OF RESIDENTIAL HEATING

	100% oil	100% wood	100% electricity[1]
Waskaganish	6 217 000$	2 780 400$	13 825 600$[2]
Eastmain	2 271 700$	953 800$	-
Wemindji	4 815 200$	2 124 300$	-

Firewood reduces the heating costs by approximately 55% when compared to oil. Obviously, it is possible to combine various proportions of wood and oil, the annual costs increasing with the proportion of oil used. The purchase and maintenance costs have also to be increased since they imply the operation of two distinct furnaces.

Furthermore, woodchip technology may develop in a near future and prove to be a feasible option for northern remote communities. One of the major advantages of this process is its automatic feeding system which significantly eases the utilization of wood furnaces.

The all-electricity scenario for Waskaganish was the most expensive one with a present worth of 13,825,600$, which more than doubled the all-oil present worth.

Despite the low cost of the 100% wood scenario, the manual feeding of the furnace is considered as a major disadvantage that is no longer acceptable. A solution to this problem is the wood-oil furnace where oil is mainly used at the end of the night and when the house is not occupied. The 75% wood - 25% oil scenario is consequently recommended.

Every new houses as well as the renovated units should be equipped with a wood-oil furnace.

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1. Produced by a mini-hydroelectric power plant.
2. This includes a proportion of the construction costs.

It is suggested that an information program should be provided to the communities on wood heating use and maintenance to avoid hazards usually associated with wood systems. Energy, Mines and Resources, Canada has already developed a program on these topics and may be a good source of information on this subject.

Fire protection measures have to be looked at too. Since present services are linked to hydro-electric project developments in the region which are to be phased out, fire protection will not to be any longer available in a near future to the CREE communities.

It is suggested that fire protection services should be negotiated with federal and provincial governments so as to maintain them adequately.

The forest capital being limited, a proper management of this resource is required. Reforestation at these latitudes is risky and expensive. More detailed studies would be necessary before going any further in that direction. A rational utilization of the present woody resources will ensure long term firewood supply at low cost.

ETUDE DE LA DEMANDE ET DE L'APPROVISIONNEMENT DE BOIS DE CHAUFFAGE POUR LES COLLECTIVITES QUEBECOISES D'EASTMAIN, WEMINDJI ET WASKAGANISH

Résumé

Objectifs

L'Administration Régionale Crie cherche à rationaliser l'utilisation du bois de chauffage à titre de source d'énergie de substitution pour le chauffage résidentiel dans les collectivités de Waskaganish (connue également sous le nom de Fort Rupert ou Rupert House), d'Eastmain et de Wemindji.

La présente étude a pour objectif de fournir les renseignements suivants:

- une évaluation de l'approvisionnement et de la demande de bois de chauffage dans les trois collectivités pendant les trente prochaines années;
- la définition des stratégies optimales d'exploitation pour le bois;
- une évaluation des coûts entraînés par les différents scénarios d'utilisation de bois et de pétrole pour le chauffage résidentiel afin de recommander les proportions optimales d'utilisation des deux sources d'énergie pour chacune des trois collectivités.

Méthodologie

La demande maximale de bois de chauffage est fonction du pouvoir calorifique du bois et de la demande d'énergie pour le chauffage. Le pouvoir calorifique dépend de l'essence, du bois et de sa teneur en humidité. La demande d'énergie pour le chauffage est calculée à partir des résultats d'une vérification énergétique basée sur un échantillon type des maisons dans les trois collectivités. Ces résultats sont ensuite extrapolés sur les trente prochaines années en tenant compte des prévisions relatives à l'évolution du secteur résidentiel.

L'approvisionnement en bois de chauffage est évalué selon une méthodologie standard et reconnue, utilisée par les spécialistes en foresterie. L'objectif est de définir la superficie offrant un potentiel sylvicole suffisant pour répondre aux besoins en énergie du secteur résidentiel des trois collectivités. La récolte doit se faire selon des méthodes qui, à long terme, ne mettent pas en danger le capital forestier. Les stratégies d'exploitation sont étudiées aussi afin de réduire les coûts au minimum tout en maximisant la production forestière.

Les opérations d'approvisionnement sont choisies parmi les méthodes à forte concentration de main-d'oeuvre afin de réduire au minimum l'achat d'équipement onéreux qui seraient sous-utilisés.

Une analyse financière complète l'étude. Sept scénarios de chauffage sont examinés comportant différentes combinaisons de chauffage au mazout et au bois afin de définir l'option qui entraînera le moins de dépenses tout en tenant compte des aspects sociaux propres à chaque scénario.

Les coûts du chauffage comprennent le coût du combustible, l'achat du matériel de chauffage, s'il y a lieu, et les frais d'entretien. Ces coûts sont actualisés au 1er janvier 1984, au taux de 6 %. Le taux est exprimé en valeur réelle, sans tenir compte de l'inflation. Tous les coûts et frais sont exprimés en dollars de 1984.

Conclusions et recommandations

D'après la vérification énergétique, les récents modèles de maison ont un bon rendement énergétique et les rénovations prévues devraient sensiblement améliorer la consommation énergétique des anciennes maisons. La température ambiante moyenne est maintenue à un niveau plus bas que la moyenne canadienne, ce qui signifie que les gens de ces trois collectivités consomment moins d'énergie pour une température extérieure donnée que le Canadien moyen. Cette conclusion entre en ligne de compte dans l'évaluation de la consommation énergétique des maisons.

Les personnes interviewées ont déclaré qu'elle aimeraient avoir un système énergétique mixte comme un calorifère à bois-mazout. Le bois est utilisé pour abaisser les coûts de chauffage et le calorifère à mazout est un appareil d'appoint qui commence à fonctionner lorsque le calorifère à bois manque de combustible (bois de chasuffage). L'alimentation manuelle du calorifère à bois n'est pas alors considérée comme un problème.

En 1983, la demande totale d'énergie était de 3 736 000 kWh, de 1 463 000 kWh et de 2 879 600 kWh pour Waskaganish, Eastmain et Wemindji, respectivement. Les projections de la demande d'énergie sont effectuées pour trente ans. Cette demande est alors convertie en demande de bois.

L'étude indique qu'il existe un potentiel forestier suffisant aux alentours des trois collectivités, pouvant répondre à leurs besoins en chauffage pour les trente prochaines années, et ce dans des conditions d'incidences environnementales acceptables. A Eastmain, la superficie visée, qui comprend les lieux de récolte traditionnelle de bois de chauffage par les habitants, contient suffisamment de bois de chauffage pour satisfaire aux besoins de chauffage à long terme de la collectivité.

A Waskaganish et à Wemindji, la récolte de bois de chauffage devra se faire sur une superficie plus grande, à cause de la population plus grande des deux villages et du capital forestier plus faible dans les environs immédiats. La distance maximale à franchir pour la récolte de bois sera de 20 km à Waskaganish et à Wemindji.

La méthode de récolte suggérée est basée sur le recours d'une main-d'oeuvre importante, et sur l'utilisation de motoneige et de traineaux pour le transport du bois. Une approche communautaire est proposée afin de garantir l'exploitation contrôlée du capital forestier et afin de favoriser une plus grande utilisation du bois comme combustible de chauffage.

Le coût de production d'une corde (4x4x8) de bois variera entre 105 $ et 125 $, selon la distance entre le lieu de récolte et la collectivité.

La valeur actuelle des coûts de chauffage quand le mazout, le bois ou l'électricité sont utilisés est présentée ci-dessous:

TABLEAU I

VALEURS ACTUELLES DU COUT DE CHAUFFAGE RESIDENTIEL

	100 % mazout	100 % bois	100%[1] électricité
Waskaganish	6 217 000 $	2 780 400 $	13 825 600 $[2]
Eastmain	2 271 700 $	953,800 $	-
Wemindji	4 815 200 $	2 124 300 $	-

Le choix du bois de chauffage réduit donc les coûts de chauffage dans une proportion de quelque 55 % par rapport au mazout. Il est évident qu'on pourrait choisir une solution dans toute la gamme des combinaisons entre le tout-bois et le tout-mazout, et que les coûts annuels augmenteront en fonction de la proportion de mazout. Il faut tenir compte aussi de l'augmentation des frais d'achat et d'entretien lorsqu'on choisit d'exploiter deux calorifères distincts.

D'autre part, la technique d'alimentation aux copeaux de bois pourrait progresser dans un avenir proche et devenir une option rentable pour les collectivités éloignées du Nord. L'un des grands avantages de ce procédé est l'alimentation automatique qui facilite sensiblement l'exploitation d'un calorifère au bois.

Le scénario tout-électricité pour Waskaganish est le plus coûteux, sa valeur actuelle étant de 13 825 600 $, ce qui fait plus que doubler la valeur actuelle de tout-pétrole.

Malgré le faible coût du scénario "bois 100%", l'alimentation manuelle du calorifère est considérée comme un gros inconvénient qui n'est plus acceptable. Pour résoudre ce problème, on suggère un calorifère à bois et mazout, le mazout étant surtout utilisé à la fin de la nuit et lorsque la maison est inoccupée. Le scénario "bois 75% - mazout 25%" est donc recommandé.

Toutes les nouvelles maisons ainsi que les maisons rénovées devraient être équipées de calorifères à bois-mazout.

L'expert-conseil recommande aussi le lancement d'un programme d'information destiné aux collectivités quant à l'usage et à l'entretien des systèmes de chauffage au bois afin d'éviter les risques qui leurs sont habituellement associés. Energie, Mines et Ressources Canada a déjà élaboré un programme sur ces sujets et peut constituer une bonne source de renseignements à cet égard.

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(1) Produit par une centrale mini-hydroélectrique
(2) Ceci inclus une portion des coûts de la construction

Les mesures de protection contre les incendies méritent aussi d'être examinées. Les collectivités Cries seront bientôt dépourvues d'un service de protection contre les incendies puisque les services actuels sont liés à l'aménagement hydro-électrique dans la région, et que ces projets d'aménagement atteignent maintenant leur phase terminale.

L'expert-conseil suggère que des services de protection contre les incendies soient obtenus par voie de négociation avec les gouvernements fédéral et provincial afin d'assurer le maintien du service selon les normes habituelles.

Le capital forestier étant limité, une gestion appropriée de cette ressource s'impose. A ces latitudes, le reboisement est risqué et coûteux. Il faudrait donc effectuer davantage d'études détaillées avant de s'engager plus loin dans cette direction. L'utilisation rationnelle des ressources actuelles en bois garantira l'approvisionnement à long terme en bois de chauffage à un faible coût.

Cette étude a été effectuée par Cogesult Inc. pour l'Administration Régionale Crie avec l'aide de subventions des Affaires indiennes et du Nord Canada et du Programme de démonstration dans les collectivités éloignées d'Energie, Mines et Ressources Canada.

INTRODUCTION

The main objective of this study is to assess the feasibility of using systematically firewood as a heating fuel in the communities of Eastmain, Wemindji and Waskaganish.

The study is divided in three parts: the firewood demand, the firewood supply and the cost comparison.

The firewood demand will be estimated through an energy audit of the residential sector, the firewood supply through a detailed forestry study and the economic analysis through comparisons with the cost of oil heating.

This is not an in-depht study of the heating systems available in the three communities. The interconnection with the Hydro-Quebec grid as well as the mini-hydroelectric power plant may represent valid alternatives but are not within the scope of this study. The exception is Waskaganish where the Consultant already made an evaluation of the investment costs for a mini-hydroelectric power plant. This information may help the reader to understand the importance of wood cost advantage but is not part of the adopted methodology.

The scope of the study is at the community level. It is therefore possible to consider a strategy as being optimal for the community, knowing that it could affect unfavourably some people.

1. BASIC DATA FOR RESIDENTIAL SECTOR

1.1 Assessment of heating energy demand

1.1.1 Methodology

The study of the residential heating energy demand includes the following steps:

- Assessment of heating energy consumption for each type of house. Older houses in Waskaganish which will be phased out in the near future have been theoretically replaced by model 1 in these calculations. The evaluation is based on:

  . computerized analysis of available house plans with the "HOTCAN"*computer model.

  . on site energy audit including an inspection of house condition, heating equipment used and life-style habits that can influence energy consumption.

- Survey of the actual oil and wood consumption per type of house.

- Electricity for heating purposes is estimated as a difference between the energy heating consumption and the oil and wood consumption derived from the survey.

- Consolidation of these data allows the determination of the heating energy balance for each community.

1.1.2 Description of the residential sector

The two major characteristics of the residential sector are:

- limited number of models

- present heating requirements are fulfilled by various combinations of wood, oil and electricity.

1.1.2.1 Description of the houses

Cedar houses

. Cedar houses built in 1975

In Waskaganish, they include a full basement, two chimneys, a wood stove located in the living room and an oil furnace in the basement. Foundations are not fully insulated. In Eastmain, these houses are without basement and have no oil furnace. In Wemindji, they have an unfinished basement and no oil furnace.

*HOTCAN is a computer model of National Research Council Canada. It measures energy consumption in homes.

. Cedar houses built in 1976 in Waskaganish

Same as above with an improved insulation in the "roof-space" and in the basement. Some of them incorporate a finished basement.

. Distribution

Waskaganish = 44 houses
Eastmain = 43 houses
Wemindji = 64 houses

White houses

. White houses built in 1977

They are equipped with one chimney and a single oil furnace. The wood basements are unfinished.

. White houses built in 1978

Same as 1977 model with concrete basements.

. Distribution

Waskaganish = 25 houses
Eastmain = 0 house
Wemindji = 6 houses

Model 1

. Model 1 built in 1979

They include a single oil furnace.

. Model 1 built since 1982

Equipped with a dual wood-oil furnace.

. Distribution

Waskaganish = 60 houses
Eastmain = 0 house
Wemindji = 40 houses

Model 11

. Model 11 built in 1983

Semi-detached houses including dual oil-wood furnaces and a three floor layout.

. Distribution

Waskaganish = 24 houses
Eastmain = 14 houses
Wemindji = 12 houses

New models to be built starting in 1985

A 24' x 32' model, semi-detached, with a half excavated finished basement and improved insulation.

A 24' x 26' model, same as above.

1.1.2.2 Heating systems efficiency

In the cedar houses, the wood stove efficiency is estimated at 55%. A more frequent maintenance would improve this efficiency. The oil furnaces in these same houses show a 60% performance. This estimate takes into account the almost complete absence of maintenance. However a maintenance program was implemented last year. The more recent oil furnaces in the old houses reach 65%.

In models 1 and 11, oil furnaces reach a 70% efficiency level and 65% for wood furnaces. These new furnaces do not offer better efficiency due to the following facts:

- utilization of green wood favors the creation of creosote deposits and condensation at the top of the chimney.
- outdoor chimney without sufficient insulation
- oversize of the oil equipments
- utilization of one chimney for two furnaces

1.1.2.3 Houses energy efficiency

Energy efficiency significantly improved in models 1 and 11 when compared to the previous models. They meet high insulation standards while the new models to be introduced in 1985 should reach top thermal insulation standards. Architectural modifications like a

thicker carcass with additional insulating material, wood framework in the basement, crossed-ply insulation in the space-roof are responsible for this higher thermal performance. The housing tightness is also improved through tighter external facing, improved caulking, air fuel with a check valve, tighter two door vestibule, etc.

The energy audit although revealed the following problems in the older houses:

- many broken window-panes
- important lack of tightness of the housing characterized by the presence of condensation in the roof-space.

These problems were temporarily fixed by the utilization of polyethylene on windows and sometimes covering a whole facing. Renovation of the old houses (white and cedar) will remedy these weaknesses.

Despite the superior quality of the models 1 and 11, the inspection revealed:

- average quality of the sliding windows.
- cold air infiltration and thin snow through the external facing.
- snow infiltration in the space-roof.

The thermal efficiency of these buildings decreases significantly because of these weaknesses.

1.1.2.4 Conclusion

Despite some weaknesses, the quality of the houses built during the last two years has significantly improved, when compared to the older houses, especially air tightness, insulation and architectural conception. Models 1 and 11 are spacious, bright and offer interesting energy efficiency. The space utilization could however be more efficient. The semi-detached conception reduces the thermal losses and the construction cost. This formula (three floors, semi-detached) does not however seem to be very popular. The two new models available in 1985 will offer a better utilization of the available space. The basement is designed to be lived in and the thermal efficiency is optimal according to the actual standards.

There is unfortunately no consideration for passive solar heating. Preliminary estimates indicate that heating energy savings of 25% to 28% could be achieved through a good house orientation and an appropriate location for the windows, which imply a special design

applicable to the new houses only. All these new houses cannot be oriented exactly toward south but there is definitely an important energy savings potential that is not presently considered.

1.1.3 Energy consumption behaviour

Room temperature varies from house to house. A fairly stable level of temperature is noted in the recent models while peaks of 25 °C were recorded in some old houses. These important fluctuations are related to the running of some wood heating equipment. The discontinuous manual feeding of the wood stoves induces large temperature fluctuations.

People will occasionally regulate the temperature when those peaks occur by leaving doors or windows opened until a satisfying temperature level is reached.

Room temperature is kept low during the night in the majority of the houses. The basement temperature is also kept low. These observations suggest the average room temperature is lower than the canadian average derived from the available statistics, reducing proportionally the heating requirements. The resulting energy savings are taken into account in the houses heating energy consumption calculations (appendix 1).

The internal heating contributions are relatively important due to the high level of occupancy (6 persons and more per house) and the large number of electric appliances found in each house. This contribution is approximately 4 000 KWh/year. The high occupancy level counterpart is the important production of humidity which is around 15 to 20 kilograms of steam per day. This high humidity level favours the presence of condensation and frost in the shell and in the insulating materials, causing damages which lead to a thermal efficiency reduction of the building.

Large frost patches were noticed in the space-roof of the old houses. The utilization of ventilators in the kitchen and in the bathroom reduce the humidity level in the recent models. The presence of a slow burning heating system in the basement creating an indraft also reduces the humidity level.

Hunting and trapping activities have no significant impact on the heating energy demand. The main reasons supporting this statement are listed below:

- creation of many sedentary occupations and school for children reduce the frequency and the length of hunting and trapping trips.

- materials used in new models do not resist as well to very low temperatures. For example, it is generally admitted that the plaster joints may crack if exposed to temperatures below + 13°C.

  Equipments do not sustain cold temperatures either. Finally, the water-heater must be emptied if the house is left without heating. It is consequently more and more difficult to leave the house not heated.

- gradual acquisition of valuable equipments make people reticent to leave the house uninhabited.

People prefer having a relative or a neighbour occupy the house during their hunting and trapping trips.

1.1.4 Attitudes towards wood heating

1.1.4.1 Waskaganish

The point of views vary according to the heating system presently in use in the house.

For the persons having only an oil heating system, the majority of them wishes to get a wood auxiliary system to lower their heating costs. This is confirmed by the high satisfaction level of people already having a dual wood-oil furnace. These persons consider to increase their wood consumption to further lower their heating bills. The exception is the persons having a full time job and having no spare time available for wood harvesting. They use only the oil furnace because no firewood is presently sold on a large basis in Waskaganish.

1.1.4.2 Eastmain

The context is very different in Eastmain since most of the houses have no oil furnaces. There is only the recently built model 11 which are equipped with a dual wood-oil furnace. The majority of the other houses are only equipped with a plain wood stove. People are using their wood stove efficiently and are fully aware of the maintenance to be done. People however expressed their frustration about being completely dependant on wood for heating. The wood stove must be fed regularly including during the night and the wood harvesting is very time consuming. The persons having a full time job are specially affected.

1.1.4.3 Wemindji

People living in cedar houses equipped with a wood stove share the concerns expressed by the Eastmain residents. The models 1 and 11 are equipped with dual wood-oil furnace as in Waskaganish but people are using the oil furnace as a stand-by unit relying heavily on wood for their heating needs.

1.1.4.4 Conclusions

Where only one heating system is present, people indicated the necessity to add a complementary heating system. Wood allows lower costs while oil provides more flexibility. A central warm air heating system with a wood-oil furnace is consequetly considered the best option by the three Communities.

Some persons presently using a single oil furnace entertain some fears regarding fire hazards associated with wood heating but they remain interested in using wood for heating. The cost advantage of wood heating lead everybody to use more wood when it is possible.

1.1.4.5 Recommendations

1. Favour the utilization of firewood by installing efficient add-on wood furnaces where it is possible.

2. To systematize wood harvesting to make firewood available for everybody.

3. If firewood is sold (not included in the monthly rental charge as for the electricity), information session should be elaborated to demonstrate the cost advantage of firewood.

4. Organize information sessions on wood heating including:

   - how to increase the wood furnace efficiency
   - fire hazards prevention
   - the maintenance and cleaning of the heating system

5. Use oil furnaces as complementary heating system.

1.1.5 Heating energy consumption

1.1.5.1 Present situation

Calculations of the heating energy consumption are detailed in appendix 1. These calculations incorporate the two major causes of thermal loss:

- heat outflow (function of the insulation)

- air leak or infiltration through lack of air tightness, kitchen and bathroom ventilators, frequency of comings and n goings of inhabitants, etc.

On the other hand, the internal heat contributions from the inhabitants, the electric appliances and the passive solar energy are also included in the calculations. All these data are derived from the inspection of a sample of houses in each community and a close study of the plans of these houses. Heating equipment and life style habits are also taken into account.

Because of the large diversity of the population heating habits, the samples defined in the proposal were enlarged to improve the energy audit accuracy. Table 1.1.1 gives the break-down of the sample for each community.

TABLE 1.1.1

ENERGY AUDIT SAMPLES

community / house model	WASKAGANISH	EASTMAIN	WEMINDJI	TOTAL
Cedar house	7	14	6	27
White house	4		2	6
Red house		1		1
Model I	16		7	23
Model II	3		2	5
Total	30	15	17	62

The heating energy demand per house in 1983 was:

Cedar houses with unfinished basements	30 400 KWh
Cedar houses with finished basements	25 000 KWh
White houses	27 200 KWh
Red houses	37 900 KWh
Green houses	35 000 KWh
Models 1	20 720 KWh
Models 11	19 800 KWh

The total heating energy demand per community is presented in Table 1.1.2.

TABLE 1.1.2

TOTAL HEATING ENERGY DEMAND
PER COMMUNITY
(KWh)

communities / house model	WASKAGANISH		EASTMAIN		WEMINDJI	
	Number of houses	KWh	Number of houses	KWh	Number of houses	KWh
Cedar houses with unfinished basement	44	1337600				
Cedar houses with finished basement			43	1075000	66	1650000
White houses	25	680000			6	163200
Red houses			2	75800		
Green houses			1	35000		
Model I	60	1243200			40	828800
Model II	24	475200	14	277200	12	237600
Total	153	3736000	60	1463000	124	2879600

1.1.5.2 Energy demand projections per community

The objective is to determine the potential firewood demand coming from the residential sector for the next 30 years. The calculations are based on the following assumptions:

- The annual heating energy demand is a function of the renovation, the demolition of old houses, and the forecasted construction .
- The housing and infrastructure program of the Cree Housing Corporation is assumed to be fully applied. Where some houses are still to be replaced at the end of 1989, it is assumed they are replaced in the following two years.

- The population's growth until 1989 is derived from the housing and infrastructure program of the Cree Housing Corporation.

- The annual population's growth rate is assumed to be 3% from 1990 to 1993 and 2.5% from 1994 to 2013 as per the terms of reference for this study.

- New houses will be built in groups of fifteen assuming an occupancy rate of 6 persons per house.

- The residential heating energy demand is derived from the heating energy consumption previously estimated in section 1.1.1.

- The heating energy consumption habits are assumed to remain constant for the next thirty years. A significant modification of some of these habits would have a direct impact on the heating energy demand forecasts.

- The new house models will be built starting in 1985. It is assumed the two models will be equally constructed, i.e. 50% of the new houses will consumed 14 000 KWh/ year while the other 50% will consume 16 000 KWh /year.

Table 1.1.3 shows the forecast of residential heating energy consumption per community. The objective of this study being the comparison of different energy mix, no sensitivity analysis is performed on the heating energy consumption since the comparison would not be affected.

The old houses will be renovated or demolished as planned by the C.H.C. The energy demand of the renovated houses is adjusted accordingly and no further energy savings are considered achievable. The new models recently built or to be built are already energy efficient and no further improvement is assumed.

1.2 Wood demand and supply

The firewood standard measure is the large cord (1.2 m. x 1.2 m. x 2.4 m.) which is equal to three small cords. A large cord contains 2.41 m^3 of solid wood. The calorific value of a large cord of black spruce is 4 350 KWh, when wood has not been stored to dry up and the wood humidity level is assumed to be 30%. The calorific value is 4 982 KWh/large cord when the wood is adequateiy dried, i.e. with a 20% humidity level.[1]

(1) p. 73, "Les systèmes de chauffage: guide du consommateur". Energy, Mines and Resources, Canada, April 1983, 87 pages.

TABLE 1.1.3

ANNUAL ENERGY CONSUMPTION FOR RESIDENTIAL HEATING
(x 1000 KWh)

years / communities	84	85	86	87	88	89	90	91	92	93	94	95	96	97
Waskaganish	3344(1)	3569	3569	3569	3894	3894	4119	4119	4119	4344	4344	4569	4569	4569
Eastmain	1392	1392	1477(2)	1437(3)	1437	1312(4)	1312(4)	1312	1312	1312	1312	1312	1537	1537
Wemindji	2860(5)	2860	3070	3295	3295	3295	2958(6)	2608(7)	2833	2833	2833	2833	3058	3058

	98	99	00	01	02	03	04	05	06	07	08	09	10	11
Waskaganish	4794	4794	5019	5369	5369	5369	5369	5369	5369	6380	6380	6380	6380	6380
Eastmain	1537	1537	1537	1537	1537	1762	1762	1762	1762	1762	1762	1987	1987	1987
Wemindji	3058	3283	3283	3283	3508	3508	3508	3733	3733	3958	3958	3958	4183	4183

	12	13
Waskaganish	6380	6380
Eastmain	1987	1987
Wemindji	4408	4408

1. 69 cedar houses are renovated.
2. 14 houses are built and 5 demolished.
3. 14 houses are built and 10 demolished.
4. 5 houses are demolished.
5. 3 houses are renovated.
6. 34 houses are built and replace 34 old houses.
7. 35 houses are built and replace 35 old houses.

1.2.1 Wood demand

1.2.1.1 Present situation

The firewood used is almost exclusively black spruce. Firewood is rarely stored more than a few days and is left outside without any protection. Harvesting is performed on requirement within a radius of 2 to 5 kilometers. Transportation is ensured by snowmobiles.

Assuming that Waskaganish is a representative community, the firewood demand actually fulfills one third of the residential heating energy demand where people may choose between wood and another energy source.

In Eastmain, 73% of the heating needs are presently fulfilled by wood. This situation could be modified in a near future since the cedar houses will be renovated and equipped with an oil/wood furnace. The same situation is observed in Wemindji.

1.2.1.2 Wood demand forecast

The maximum wood demand for the next thirty years is calculated as a function of the:

- annual heating energy demand forecast
- wood calorific value
- energy efficiency of the heating systems

The annual heating energy demand was previously estimated in section 1.1.4. The calorific value of a large cord of wood is assumed to be 4982 KWh as stated in the previous section.

The energy efficiency of the wood heating furnaces is 65% assuming the implementation of a special maintenance program for wood furnaces.

Therefore, the 1984 wood demand in Waskaganish is:

$$\frac{\text{Annual heating energy demand}}{\text{Wood calorific value} \times \text{Heating equipment efficiency}} = \frac{3\,344\,000}{4\,982 \times .65} = 1033 \text{ large cords}$$

The table 1.2.1 shows the maximum annual firewood demand forecast per community.

TABLE 1.2.1

MAXIMUM ANNUAL FIREWOOD DEMAND FOR RESIDENTIAL HEATING
(Cords of wood)

years / communities	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98
Waskaganish	1033	1102	1102	1102	1202	1202	1272	1272	1272	1341	1341	1411	1411	1411	1480
Eastmain	430	430	456	444	444	405	405	405	405	405	405	405	475	475	475
Wemindji	883	883	948	1018	1018	1018	913	805	875	875	875	875	944	944	944

	99	00	01	02	03	04	05	06	07	08	09	10	11	12	13
Waskaganish	1480	1550	1658	1658	1658	1658	1658	1658	1970	1970	1970	1970	1970	1970	1970
Eastmain	475	475	475	475	544	544	544	544	544	544	613	613	613	613	613
Wemindji	1014	1014	1014	1083	1083	1083	1153	1153	1222	1222	1222	1292	1292	1361	1361

1.2.2 Wood supply

1.2.2.1 Wood potential

Wood availability

This section includes a short description of the adopted methodology for the assessment of wood potential. The detailed methodology, calculations and tables are presented in appendix.

The main component, in the perspective of using wood as fuel, is the avaibility of woody substance in the vicinity of the Waskaganish, Eastmain and Wemindji communities. The volume of woody substance must not only be available to supply present needs but it must also meet with the demand for the next thirty years, while ensuring that the forest capital is not irreversibly over-exploited and that the environment is not badly affected by the logging of this woody substance.

In order to ensure this availability, an evaluation of the forest potential was undertaken near the three comunities. The territories studied include the major woody area surrounding the three villages.

Since no forest maps or forest inventories were available to establish the present available woody substance for these communities, forest maps were drawn and an exhaustive forest sampling was undertaken to fill this demand.

This forest sampling and the related mapping will determine the total yield for the territories to be analyzed and the annual sustained yield.

The main phases of realization needed to determine the total yield of the woody substance are:

- photo-interpretation
- field sampling
- compilation of inventory work
- cartography
- total yield

Table 1.2.2 shows the total yield for each community and table 1.2.3 indicates the total yield distribution per species for each community.

TABLE 1.2.2 TOTAL YIELD FOR EACH COMMUNITY

COMMUNITY / REGROUPING OF STRATA	VOL/HA (m3)	WASKAGANISH AREA (ha)	WASKAGANISH VOL. (m3)	EASTMAIN AREA (ha)	EASTMAIN VOL. (m3)	WEMINDJI AREA (ha)	WEMINDJI VOL. (m3)
E B3 120	107,5	2 966	318 845	1 203	129 322	232	24 940
E C3 120	75,7	4 398	332 928	4 097	310 143	4 191	317 259
E D3 120	73,0	1 193	87 089	1 290	94 170	6 016	439 168
E B4 120	79,6	118	9 393	177	14 089	10	796
E C4 120	45,0	1 097	49 365	1 817	81 765	1 664	74 880
E D4 120	45,6	775	35 340	382	17 419	3 570	162 792
Tr C3 90	191,9	123	23 604	6	1 151	23	4 414
Pg C4	39,1	--	--	61	2 385	--	--
Pg D4	34,5	--	--	24	828	--	--
Bb RR C4	52.4	369	19 336	92	4 821	153	8 017
Regeneration	--	187	--	219	--	393	--
Regenerating	--	852	--	302	--	1 228	--
Unproductive & non forest land	--	31 365	--	17 830	--	27 272	--
TOTAL		43 600	875 900	27 500	656 093	44 800	1 032 266

TABLE 1.2.3 TOTAL YIELD DISTRIBUTION PER SPECIES FOR EACH COMMUNITY

SPECIES \ COMMUNITY		AREA					
		WASKAGANISH		EASTMAIN		WEMINDJI	
		(m3)	(%)	(m3)	(%)	(m3)	(%)
BALSAM FIR	(SAB)	87 045	9,9	62 460	9,5	92 771	9,0
WHITE SPRUCE	(EPB)	101 604	11,6	94 519	14,4	259 095	25,1
BLACK SPRUCE	(EPN)	648 422	74,0	484 019	73,8	656 436	63,6
JACK PINE	(PIG)	1 670	0,3	7 263	1,1	8 422	0,8
TAMARAC	(MEL)	2 990	0,3	3 530	0,5	6 155	0,6
BALSAM POPLAR	(PEB)	14 056	1,6	521	0,1	2 975	0,3
TREMBLING POPLAR	(PET)	10 109	1,2	1 074	0,2	1 914	0,2
WHITE BIRCH	(BOP)	10 004	1,1	2 707	0,4	4 498	0,4
TOTAL		875 900	100,0	656 093	100,0	1 032 266	100,0

1.2.2.2 Annual yield

Systematic removal of the woody substance for a given territory, without considering its regeneration capacity may eventually lead to:

- serious shortage of supplies
- considerable cost price increase of raw material due to its remoteness; and
- important environmental problems.

As for the Waskaganish, Eastmain and Wemindji communities, foreseen demographic increase, combined with a policy favouring utilization of wood as a means of fuel may provoke future problems if the forest capital is not rationally exploited as per established principles.

Sustained yield

This fundamental principle, which assures conservation and perpetual utilization of the resource, is defined as the woody substance volume exploitable annually as planned without causing stock breakage. This occurs when, by lack of woody substance at maturity, it becomes impossible to harvest anticipated volumes.

There are many methods to calculate allowable cut, some very simple and others more complex. The choice of the methods depends on many factors such as natural factors, availability and precision of basic data, etc.

The choice of the method is definitely related to the intensity of management practiced. Under extensive management and especially in its initital stages, forest information is limited. With more intensive management, better forest information and accumulated production experience, the nature of the problem changes. Greater sophistication and accuracy are possible.

In areas where the demand for timber is lower than the available supply, close accuracy to determine cutting is not of the utmost importance, and general estimates obtained by overall methods may suffice. However, where demand pressures available supply, the allowable cut becomes a limit of critical importance and accuracy is important.

However, in the present case, there are little or no available data for the territory not being located inside commercial forest limits and consequently it would be needless to seek a high precision level by using a sophisticated method.

Territorial Entity

Territories to be analysed have been submitted by the Cree Regional Authority. In cases where the submitted territory did not meet 100% of the demand for the given objective, e.g. 30 years, the territory was expanded to fill this objective. Localization of these new territories were realized by using synthesis forest maps at scale 1:125 000 carried out by "le M.E.R. du Québec" for the said regions. Priority was given to the territories close to the communities.

It is important to remember that annual yield will be calculated exclusively for the territories delineated on the maps hereattached and this independently of territorial subdivisions contained in the James Bay Agreement.

Territory Zoning

In order to calculate annual yield of the woody substance, it is important to zone the territory as to foreseen utilizations, woody substance yield, environmental protection, hunting and fishing, etc, since unfit unavailable areas for woody substance production must be extracted from the calculation of allowable cut.

Since members of each community make an intensive use of their forest resources, conservation of all their resources must be assured not only for a given period but also for the future.

However, in the present context, it must be assumed that a portion of the resource will be used to produce woody substance for energetic purposes and consequently there will be consequential effects on other resources. These could be minimized by choosing the most advantageous harvesting areas and proper method of harvesting.

Production of Woody Substance

It is obvious that logging of the forest resource to produce woody substance may only be realized on productive forest lands as shown in table 5.1.1 of appendix 2.

However, considering that forest stands regenerating and in regeneration do not presently have sufficient volume to be logged and considering the particularly slow growth of stems in that region, anticipated volumes for these areas will not be available over an expected period of 30 years. Our calculations will thus be based on areas occupied by productive young and mature stands.

Furthermore, firewood consumed is essentially centered around resinuous species such as spruce, therefore total volume of leafy species will be excluded from present compilations.

In addition, many productive forest stands identified on the attached maps do not present an interest as far as forest logging because of their small area, their poor yield/hectare and mostly because of their remoteness to all important concentrations of woody substance. These areas and volumes have been excluded from annual availability calculations.

Protection of the Environment

Utilization of the forest resource to produce woody substance has certain effects on the surrounding environment, notably on fauna, riparian habitat and water quality. However a variety of measures may be applied in order to minimize clearing impact on the surrounding environment.(1)

Some of these measures contain considerable constraints in regards to the forest resource utilization to produce woody substance and consequently these areas must be excluded from the yield calculation.

These measures refer to the protection of riparian habitats, hydrographic systems and essential fauna habitats (devastations, etc.). It is indeed essential to keep a wooded strip along water streams and lakes, not only to assure an adequate protection of the hydrographic network (water quality, etc) but also for riparian habitats. Since the terrestrial fauna is directly dependant upon the riparian zone and uses it more than all other habitats, it is certainly not an element to be overlooked by the Cree Communities.

Considering the restrictions related to the protection of the environment, woody substance volumes included in a protection strip of 30m, on either side of the water courses have been systematically deducted for each communities.

Also, although wood harvesting is not systematically disastrous to fauna if carried out as per defined standards, it may be so in places of fauna gathering and for certain specific species. To this end, these zones represent a resistance area to forest harvesting.

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(1) M.E.R., Government of Quebec, Guide d'aménagement du milieu forestier, 1977, 158 p.

TABLE 1.2.4 TOTAL YIELD AVAILABLE FOR HARVESTING

COMMUNITY / REGROUPING OF STRATA	VOL/HA (m3)	WASKAGANISH AREA (ha)	WASKAGANISH VOL. (m3)	EASTMAIN AREA (ha)	EASTMAIN VOL. (m3)	WEMINDJI AREA (ha)	WEMINDJI VOL. (m3)
E B3 120	107,5	1835	197,263	1 093	117 498	183	19 673
E C3 120	75,6	3445	260,442	3 760	284 256	3 267	246 985
E D3 120	73,0	1105	80,665	1 228	89 644	4 362	318 426
E B4 120	79,6	92	7,323	167	13 293	10	796
E C4 120	45,0	1005	45,225	1 685	75 825	1 427	64 215
E D4 120	45,6	723	32,969	363	16 552	3 256	148 474
Tr C3 90	--	--	--	--	--	--	--
Pg C4	39,1	--	--	61	2 385	--	--
Pg D4	34,5	--	--	24	828	--	--
Bb RR C4	--	--	--	--	--	--	--
Regeneration	--	--	--	--	--	--	--
Regenerating	--	--	--	--	--	--	--
Unproductive & non forest land	--	--	--	--	--	--	--
TOTAL		8205	623,887	8 381	600 28T	12 505	798 569

TABLE 1.2.5 TOTAL YIELD AVAILABLE FOR HARVESTING: distribution per species

COMMUNITY / SPECIES	AREA					
	WASKAGANISH		EASTMAIN		WEMINDJI	
	(m3)	(%)	(m3)	(%)	(m3)	(%)
BALSAM FIR (SAB)	63,694	10.2	57,547	9,6	71 344	8,9
WHITE SPRUCE (EPB)	85,080	13.6	88,083	14,7	198 091	24,8
BLACK SPRUCE (EPN)	471,025	75.6	447,313	74,5	518 312	64,9
JACK PINE (PIG)	1,547	0.2	4 055	0,7	6 107	0,8
TAMARAC (MEL)	2,541	0.4	3,283	0,5	4 715	0,6
BALSAM POPLAR (PEB)	-	-	-	-	-	-
TREMBLING POPLAR (PET)	-	-	-	-	-	-
WHITE BIRCH (BOP)	-	-	-	-	-	-
TOTAL	623,887	100%	600 281	100%	798 569	100,0

Nevertheless, there are no important resistance areas in the territories under study and consequently none were deducted.[1] However, special attention will be given to those fauna gathering areas while determining the most advantageous harvesting areas.

Taking into account the additional restrictions related to harvesting of the forest resource to produce woody substance, available areas and volumes to this end are the following.

Areas and Volumes Available for Harvesting

Following the restrictions enumerated in the preceding paragraphs, areas and volumes available for harvesting are presented in table 1.2.5 and distribution per species in table 1.2.6.

Basis of Calculation of Annual Yield

The calculation of the annual yield is based on the following hypothesis:

1. Rotation, which is summarized as being the period of time required to obtain a new stand at maturity, has been set at 120 years, taking into account that on the north boundary of the commercial forest on more favcurable sites rotation varies between 75 to 120 years.[2]

2. A natural regeneration of the stands, mainly by layering.

3. This natural regeneration will produce at maturity, stands similar to those already harvested.

4. Annual net woody stock increment is inexistent because of its advanced state of maturity.[3]

5. Woody stock will last indefinitely (constant total volume)

6. There will be no major natural perturbations (forest fires, windfalls, etc.) that will reduce woody stocks. (see p.38)

7. The creation of artificial stands would not reduce the period of rotation. The seedlings used for reafforestation purpose are usually issued from seeds picked in that same region. These seedlings once subject to the same growing conditions will grow at the same rate than the natural seedlings.

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(1) S.O.T.R.A.C. personal communication.
(2) Service des Plans d'aménagement du M.E.R.
(3) Jacques Fortin, S.I.F. du M.E.R., La Croissance forestière au Québec, Octobre 1983.

These hypothesis only allow the utilization of a fairly simple method of annual yield evaluation. More sophisticated methods require data that are only available for the commercial forests. The precision level of the different methods is about the same but the confidence interval is reduced when sophisticated methods are used. Forest specialists cannot however evaluate to what extent the confidence interval is decreased.

Calculation of annual yield

Annual yield will be established using the following equation:

$$Ya = \frac{Ga}{R}$$

where
Ya = annual yield
Ga = actual growing stock
R = rotation in years

Application of this formula give the following results for each community.

Table 1.2.6 - Annual yield for each community (allowable cut)

Community	Yield (m^3)	Yield (large cord)	Maximum wood demand in 2013 (large cord)
Waskaganish	5 200	2 158	1970
Eastmain	5 000	2 087	613
Wemindji	6 655	2 761	1361

This indicates that the wood supply can meet the wood demand for the next thirty years. The harvesting will be performed on areas which are fairly close to the communities.

1.2.2.3 Most advantageous harvesting areas

Selection criteria

Productive forest lands do not all have the same interest for logging. Many factors may influence choice of cutting areas, in this case, utilization of the woody substance. Without being limited to them, these factors are:

- Proper choice of species stem;
- Parameters of stems in forest stands
- Forest stands parameters
- Topography of the area
- Transport distances
- Harvesting method
- Infrastructures

And finally, factors related to protection of the environment.

However in the present context many of these factors are of no consequence.

Choice of species

For the territories under study, choice of species is not a determining factor since the forest cover contains nearly 90% spruce, and secondary species are not more compatible to produce firewood than the previous and furthermore, are insufficient to meet demand. Consequently, species may not be selected at this point.

Parameters of stems in forest stands

Diameter, height and form of stems are determining elements in the selection of trees intended for production of a particular product. Moreover, some commercial species are bound by specific exploitation standards by the Ministry of Energy and Resources particularly in regard to diameter of stump cut.

However, firewood, being generally recuperated as a by product of exploitation, is not bound by any government standard and needs only to comply with market requirements. In the present context, considering the harsh environmental conditions and uniformity of forest cover, available forest product is utilized without any form of restriction.

Forest stands parameters including forest cover

This factor, being the only element that could interfere in the choice of preferential harvesting areas, will be analyzed in depth later on.

Topography of the area

There are no topographical obstacles preventing exploitation of forest stands in the territories under study Transportation being done in the winter season, rivers would not create any problem for this operation.

Transport distances

In the area under study, communities being located within a maximal radius of 30 km, transport distances do not present any difficulty in regards to the preferential harvesting areas. It is evident, as demonstrated in the chapter concerning forest exploitation, that the cost of transport is higher on a distance of 25 km than on 10 km.

However, this difference of cost has hardly any effect on the benefit of the project, as would be the case if we were to consider distances of 100 to 150 km. Thus this element was not judged significant in the choice of preferential harvesting areas.

Method of exploitation

The method of exploitation recommended, like other factors analysed previously, is not determinant in the choice of preferential harvesting areas. To be sure, if we refer to productivity of forest workers harvesting firewood, the choice of a method of exploitation becomes an important element, but when productivity and costs of production of such methods are accepted, the choice of preferential harvesting area does not depend on the method recommended but rather on forest stands which will yield the expected productivity.

Infrastructures

The method of exploitation recommended does not necessitate important basic infrastructures. The absence of need of roads and support equipments, for one, allows a greater flexibility as to choices of exploitation sites and represents an advantage in regards to choice of preferential harvesting areas.

Protection of environment

From the outset, forest exploitation is not an activity incompatible with environmental protection but could become under certain circumstances a forest management tool beneficial to fauna.(1)

In fact, the method of exploitation recommended with its operations restricted to the winter season, favors the use of snowmobiles which eliminates the need for road foundations, minimizing damages to the environment. Moreover, the conservation of screens of vegetation, as recommended in article 2.3.2, along watercourses and lakes in order to protect the water network and riverside habitats, reduces considerably the environmental input of forest exploitation.(2)

Finally, the absence of large fauna concentration in the territories under study eliminates almost totally the fears related to environmental damages.

Forest stands parameters including forest cover

As in forest lands, productive forest stands do not all have the same interest in forest exploitation.

Evidently, forest stands capable of high yield will be the privileged target of exploitation works. It is easy to understand that high yield stands whose stem volumes are also high will be particularly favored.

Based on results of samples taken in areas surrounding the communities, the forest stands present the following parameters .

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(1) Gouvernement du Québec, Ministère du Loisir, de la chasse et de la pêche, Direction générale de la faune, La Protection des habitats fauniques au Québec, annexe B, Les activités d'altération des milieux et leur répercusion sur la faune, avril 1983, 173 p.

(2) M.E.R. Québec, Groupe de planification sectorielle, Guide de l'aménagement du milieu forestier, juin 1977, 158 p.

Table 1.2.7 Forest stands parameters sampled on the territories of the communities.

GROUP STRATA	Volume per hectare (m^3)	number of stems (ha)	mean diameter (cm)	mean volume (m^3)
1- E B3 120	107,5	1522	14,4	0,070
2- E C3 120	75,6	974	14,7	
3- E D3 120	73,0	758	15,5	0,096
4- E B4 120	79,6	1407	13,4	0,056
5- E C4 120	45,0	933	12,9	0,048
6- E D4 120	45,6	755	13,5	0,060
7- TrC3 90	191,9	370	27,4	0,518
8- PgC4 (1)	39,1	1010	12,5	0,039
9- PgD4 (1)	34,5	1136	11,8	0,030
10-BbRRC4 (1)	52,5	470	17,0	0,112

Stands 7 and 10 must be removed from preferential harvesting areas considering these stands were excluded in the calculation of possibility (see section: annual yield).

In order to understand the subsequent choice, it is essential that the following process be applied: the least operation forest workers have to accomplish, the easier it will be to attain the anticipated production. Thus, the more the volume per hectare exploited and the more the volume of stems in the stands, the better the chances to attain the desired productivity.

(1) Data from Quebec Ministry of Energy and Resources for Eastmain region (see chapter 1).

This is why stratum EB3120 has been retained in preference to all others. However, since this stratum does not cover a sufficient surface areas to meet the entire demand, specially for the Wemindji community, two other stratum with good yield possibilities were added in order to attain the desired production (EC3120 ED3120).

Preferential harvesting areas are defined in the cartographic documents enclosed.

Obviously, stands excluded in the calculation of annual yield have also been excluded from preferential harvesting areas. Likewise, screens of vegetation preserved along watercourses and lakes act as boundaries for preferential harvesting areas.

Cutting sequence

The preferential harvesting area stocking a volume highly superior to the total demand for the next thirty years, the annual logging sites can be chosen with regard to:

- the annual energy demand
- the exploitation costs
- the harvesting method
- some additional environmental protection measures

Table 1.2.8 Comparison of total demand for thirty years to preferential harvesting areas expected yield.

Community	Total demand (m^3)	expected yield (m^3)	total demand/ expected yield
Waskaganish	110,200	538,370	20%
Eastmain	35,400	491,398	7%
Wemindji	75,600	585,084	13%

Annual consumption level

The importance of firewood in the total energy demand of communities will have an effect on the choice of exploitation sites.

A reduced annual demand will allow either the exploitation of limited isolated surfaces left out in other circumstances or the prolonged use of a particular site reducing the areas to be harvested annually.

The choice of the exploitation sites is done according to the assumption that firewood will fulfill 100% of the residential heating needs. The annual quantity of wood required to meet the energy demand, according to definite consumption level is compiled in the table 1.2.10.

The annual harvested surface areas for the next thirty years are determined from this table.

The forest stands that cannot provide a volume equal or greater than the annual average demand are not considered.

Protection of environment

In addition to the protection measures such as the protection of the riparian habitats, hydrographic systems and the essential fauna habitats, the large number of available exploitation sites allows a more selective choice of the latters. The conservation of the woody areas around the communities and their substructure such as the airport and the roads is added to the other protection measures to be considered. No exploitation will be allowed inside a radius of 2 to 3 kilometers around each community.

Exploitation costs

The transportation distance having a direct impact on the exploitation costs, the exploitation sites are concentrated inside a radius of 10 kilometers around the communities.

To ensure that the productivity of the forest workers is maximum, the exploitation sites will be usually located inside of the most productive forest stands (EB3 mi - EC3 mi). This will help keeping the exploitation costs as low as possible.

Method of exploitation

The method of exploitation has a major effect on the natural reafforestation of the harvested areas. Some experiments are presently realized in the north-western Quebec which demonstrates that the strip cutting favours the natural reafforestation of the black spruce. The forest stands choosen are large enough to permit this method of exploitation and consequently favouring the implementation of natural seedlings. This method implies that the forest stand is divided in strips of 60 meters, one being cut, the next left untouched and so on.

Localization of the exploitation sites

The selection of the exploitation sites is based on the annual demand presented in table 1.2.9 and the criteria previously presented. The localization is indicated on the maps presented at the end of this report.

Taking into account the variables that can influence the size of the annual harvested areas, the exploitation sites were regrouped to form harvesting areas that can supply firewood for periods from 3 to 10 years.

Variables influencing the size of the harvested areas

For the purpose of this study, the annual firewood demand was determined according to certain hypothesis. The real energy demand that will occur year after year may vary depending on the evolution of the following variables:

- the percentage of the residential heating demand fulfilled by wood
- the calorific value of wood
- the furnaces efficiency
- the population growth

Also, from a forestry standpoint, the volume per hectare of two strata of the same category may vary from the average. This will also influence the annual harvested area. The natural perturbations and future substructure works may also influence the harvested areas.

A better knowledge of the selected areas and a continuous update of the energy demand evaluation will allow to define with precision the exploitation sites.

Annual potential and demand

The comparison of annual potential yield for each communities to the demand as established by the energy audit and population growth forecast allow us to determine the quantity of firewood needed in the total energy requirement for each community.

Notwithstanding the firewood demand, the annual and total potential yields are superior to the maximum annual demand and the actual total anticipated for the next thirty years.

The following table summarizes the capacity of firewood to fill energetic needs of each communities.

TABLE 1.2.9 ANNUAL QUANTITY OF WOOD REQUIRED TO MEET THE HEATING ENERGY DEMAND

COMMUNITY / YEAR	WASKAGANISH (m^3)				EASTMAIN (m^3)				WEMINDJI (m^3)			
	100%	75%	50%	25%	100%	75%	50%	25%	100%	75%	50%	25%
1984	2490	1865	1244	622	1036	776	518	258	2128	1595	1065	533
85	2656	1993	1328	665	--	--	--	--	--	--	--	--
86	--	--	--	--	1099	824	549	275	2285	1714	1142	571
87	--	--	--	--	1070	803	535	268	2453	1839	1227	612
88	2897	2174	1448	725	--	--	--	--	--	--	--	--
89	--	--	--	--	976	733	489	243	--	--	--	--
90	3066	2299	1533	766	--	--	--	--	2200	1651	1101	549
91	--	--	--	--	--	--	--	--	1940	1456	971	484
92	--	--	--	--	--	--	--	--	2109	1581	1053	528
93	3232	2424	1617	807	--	--	--	--	--	--	--	--
94	--	--	--	--	--	--	--	--	--	--	--	--
95	3401	2550	1699	851	--	--	--	--	--	--	--	--
96	--	--	--	--	1145	858	571	287	2275	1706	1138	569
97	--	--	--	--	--	--	--	--	--	--	--	--
98	3567	2675	1783	892	--	--	--	--	--	--	--	--
99	--	--	--	--	--	--	--	--	2444	1957	1222	610
2000	3736	2800	1868	933	--	--	--	--	--	--	--	--
01	3996	2996	1998	998	--	--	--	--	--	--	--	--
02	--	--	--	--	--	--	--	--	2610	1957	1306	653
03	--	--	--	--	1311	983	656	328	--	--	--	--
04	--	--	--	--	--	--	--	--	--	--	--	--
05	--	--	--	--	--	--	--	--	2779	2085	1388	694
06	--	--	--	--	--	--	--	--	--	--	--	--
07	4748	3562	2374	1188	--	--	--	--	2945	2210	1473	737
08	--	--	--	--	--	--	--	--	--	--	--	--
09	--	--	--	--	1477	1109	740	369	--	--	--	--
10	--	--	--	--	--	--	--	--	3114	2335	1557	778
11	--	--	--	--	--	--	--	--	--	--	--	--
12	--	--	--	--	--	--	--	--	3280	2461	1641	819
13	--	--	--	--	--	--	--	--	--	--	--	--
TOTAL DEMAND	110196	82647	55098	27549	35409	26557	17705	8852	75644	56733	37822	18911
ANNUAL AVERAGE	3673	2755	1837	918	1180	885	590	295	2521	1891	1261	630

Table 1.2.10

Summary of availability and demand for the next thirty years

Details \ Communities	WASKAGANISH (m^3)	EASTMAIN (m^3)	WEMINDJI (m^3)
Annual possibility	5 200	5 000	6 655
Maximum annual demand	4 748	1 477	3 280
Total possibility	156 000	150 000	199 650
Total demand	110 200	35 400	75 600
Difference	45 800	114 600	124 050
Total possibility vs total demand (%)	140	425	265

Effect of natural perturbations on the annual yield possibilities

A natural perturbation could hardly endanger the wood potential availability. In Waskaganish for example, the total possibility for the following thirty years is equivalent to 1.4 time the total demand. If the sustained yield hypothesis is dropped, the wood potential included in the most advantageous harvesting area is five times higher than the toal demand (table 1.2.8). Moreover the total yield available for harvesting is six times superior to the total demand (table 1.2.4) and there is also some wood potential available next to the presently studied areas.

All these ratios being even more favourable for Eastmain and Wemindji, the natural perturbations could not endanger the firewood availability.

1.3 Oil and electricity supply

1.3.1 Oil

The "Société de développement autochtone de la Baie James" (SODAB) is in charge of the purchase and the distribution of heating oil in the three communities. The oil used is classified #1, a very refined product which has a low freezing point. Its calorific value is: 10.6 KWh/litre.

1.3.2 Electricity

Electricity is provided by a generating set upon demand. The Ministry of Indian and Northern Affairs Canada is in charge of the purchase of required diesel and the management and distribution of generated electricity.

This energy is mainly used for basic electrical needs, i.e. electric appliances, water-heater, public lighting system, etc. A small portion of this production is however used to heat houses through electrical baseboards or similar devices. The electricity contribution to heating is estimated by comparison between the estimated total consumption and the observed wood and oil consumption.

1.4 Unit energy cost

1.4.1 Oil

Present cost

SODAB has the responsibility to purchase, manage and distribute the heating oil to the three communities. This organization buys once a year heating oil in bulk, supervise the transportation and manage the storage and the distribution.

Transportation costs represent half of the selling prices in the James Bay region. In 1983, SODAB bought its oil in Toronto at 0.31$/litre. To this price was added transportation, storage and administration costs giving selling prices of:

- Waskaganish = 0.674$/litre
- Eastmain = 0.723$/litre
- Wemindji = 0.720$/litre

Oil prices forecast

All costs are expressed in 1984 dollars. Price variations are therefore expressed in real terms as a function of the variations of the general price index. For example, in 1984, the Economic Council of Canada forecasts a heating oil price increase of 5.1% and a general price increase of 5.4%. This means the heating oil price in constant dollars will decrease by 0.3%.

The most recent general price index forecast from the Economic Council of Canada is:

5.8% in 1985
6.3% in 1986
6.5% in 1987

COGESULT assumes the general price increase will be constant after 1987 at 6.5%.

The price variations of heating oil bought in Toronto is based on the Economic Council of Canada's forecast for 1985 to 1993 (appendix 4).

COGESULT assumes the oil price will increase at a rate of 6.5% per year between 1994 and 2004 and at a rate of 8.5% for the following ten years. These forecasts take into account the gradual decrease of the world petroleum reserves.

Heating oil prices in James Bay include important transportation costs which represent approximately 50% of the selling prices. It is assumed that transportation costs will vary according to the general price index variations. For example, a price increase of the heating oil in Toronto that would be 2% higher than the general price increase will lead to a selling price increase of 1% in the Cree communities.

Oil price in Waskaganish (OPW) = Oil Price in Toronto (OPT) + Transportation (TR)

$$\Delta OPW = (.5 \times \Delta OPT) + (.5 \Delta TR)$$

if $\Delta OPT = 2\%$
$\Delta TR = 0\%$

$$\Delta OPW = (.5 \times 2\%) + (.5 \times 0\%)$$

$$\Delta OPW = 1.0\%$$

Table 1.3.1 shows the variation of the heating oil selling price in the Cree communities when expressed in constant dollars.

Oil prices forecast

Table 1.3.1

Years	Price variations (%)	Selling price ($/litre)		
		Waskaganish	Eastmain	Wemindji
1984	-	.674	.723	.72
1985	-.35	.672	.72	.717
1986	0	.672	.72	.717
1987	-.75	.667	.715	.712
1988	-.06	.663	.711	.708
1989	-.015	.662	.710	.707
1990	-.55	.658	.706	.703
1991	-.45	.655	.703	.7
1992	-.45	.652	.699	.697
1993	-.55	.648	.696	.693
1994-2004	0	.648	.696	.693
2005-2013	1	.655 to .716	.703 to .768	.7 to .765

1.4.2 Wood

1.4.2.1 Harvesting methods

Harvesting methods may be divided into three distinct groups: the conventional or manual method, the semi-mechanized method and the mechanized method.

These three methods are only applicable if the Cree communities decide to adopt a commercial approach for wood harvesting. This implies the creation of a specific organization in charge of the harvesting and distribution of the firewood.

In order to ensure the success of this enterprise, Cogesult suggests that Cree people should be consulted as to know if they accept this centralization of the operations and consequently forego harvesting their own firewood.

Mechanized method

The characteristic of this method is that all its operations, whether cutting, skidding, branching or loading and transportation, are

carried out by uni-bi-or multifunctional machinery. The forest workers do not manipulate the woody substance, this method is used only by important forest companies producing hundreds of thousands of cubic meters annually.

Semi mechanized method

This method is similar to the first one except that cutting of stems is done by a forest worker and that all other general operations are carried out by uni-functional machinery. This method is also used by important forest companies.

Conventional method

The conventional method consists in (felling) cutting, branching and topping stems manually, hauling, loading and transportation operations are assumed by a uni-functional machinery - all categories - depending upon whether operations are on a commercial or private scale and whether transportation of wood is in logs or full length.

This method has been largely employed but is now less and less used for commercial operations taking into account working conditions, accident risks and a much lower productivity rate than with semi and mechanized methods. However, this method is wide spread amongst small private producers.

1.4.2.2 Choice of the harvesting exploitation method

Without undergoing an extensive analysis of the afore-mentioned harvesting systems, it is evident that semi and mechanized methods, taking into account environmental conditions, absence of road infrastructures and supporting equipment, and the low volume harvested annually, cannot be recommended for firewood production. In fact, these two methods do not meet with objectives that lead to the choice of the method, that is, the utilization of equipment which is:

- familiar to the communities;
- permitting a minimum spare parts inventory;
- avoiding outside specialized labour for repairs and maintenance;
- requiring little initial investment and;
- protecting present recuperation method of the woody substance,

and the maximization of the communities economic benefits in the form of salaries and services, and finally permitting a good flexibility in the choice of harvesting sites. Only the conventional method really meets these objectives.

This conventional method is similar to the method presently in force in the three communities. The utilization of snowmobiles and sleighs for wood harvesting is already widespread.

It is performed on a family basis instead of a communal approach and the frequence of harvesting is a function of the heating needs and the people free time availability . People cut wood for a few days of heating needs up to two weeks of heating needs. The wood harvesting is not concentrated in some delimited areas. It can be randomly performed inside a radius of 10 km. around the communities. Wood is transported in logs or full length and is piled up near by the houses.

1.4.2.3 Description of retained harvesting method

As pointed out earlier, the conventional method consists in felling, branching and topping stems manually whereas hauling, loading and transportation operations are performed by uni-functional machinery. It is precisely at this level of operations that the method retained is singled out.

Felling, branching and topping

The objective of these operations is to retain, for subsequent operations, only the merchantable stem 10 cm + over. D.B.H., i.e. from the stump to the minimum diameter limit, being normally 9 cm.

At this point, in the present circumstances, nothing prevents from recuperating a smaller diameter limit; this would slightly increase harvested volume areas per unit.

Hauling and transportation of wood

It is precisely at this level of operations that this retained method is singled-out. In fact, the method considered is related to the one presently in force at the community level, i.e. utilization of snowmobiles and sleighs specially conceived for wood transport. This proven method is used at a large scale on private lands of southern Quebec.

Instead of using a hauler to move stems from cutting area to an accessible truck dumping landing, building and maintaining a winter road; using equipment for loading and unloading trucks, and finally logging of stems either at a landing dumping area or at some stocking area, the stems are immediately logged on the cutting area, piled on place, loaded manually a year after on sleighs and from there, transported by snowmobiles directly to each residence.

This scenario offers the advantage, other than those enumerated beforehand, of not relying on one or two machines on which hauling and transportation operations, would depend on.

1.4.2.4 Detailed analysis of harvesting method

The application of this method is simple, a three man crew is in charge of loading logs converted by 6 wood-cutters. In fact, wood-cutters' productivity has been established at 5 m^3/day whereas the transport and loading crew productivity has been established at 30 m^3.

Logs are delivered directly to residences and cut into 16" billets. No centralized storing area will be necessary.

Since firewood must preferably be stored for drying during one year, the "cut and pile" method will be used. The wood will be piled on the harvesting site and distributed next winter directly to the houses. Each house will have to keep reserves for the Spring and Fall seasons.

1.4.2.5 Cost of woody substance

Exclusion

Because of proximity of cutting area and recommended method, following costs are excluded from present estimations:

- purchase and installation of camps
- logging roads
- food
- etc.

The cost of a forest fire protection program has usually to be included in the total cost of the woody substance. This would however not be realistic for small scale operations in northern remote communities. Such a program would cost 100 000$ (appendix 3) annually, which would increase the cost of a cord of wood by 50%. Moreover, this excludes the cost of fire fighting which may be very important. No cost can consequently be added before the Cree communities undertake negotiations with the concerned Ministries and a cost sharing of these programs has been determined.

CUTTING RIGHTS

As stipulated in the "Convention de la Baie James et du Nord Québécois", no cutting right has to be paid to the "Ministère de l'Énergie et des Ressources du Québec" on the 1A and 1B lands. Wood harvesting on land category II and III necessitates the obtaining of a cutting permit from the above mentioned Ministry.

The cutting rights for firewood production are 1.00$ per cubic meter of apparent wood. It is however possible to request a regrouped domestic cutting permit with no cutting rights. Regardless of this option, an immunity from the payment of cutting rights could be negotiated with M.E.R. Quebec in cause of the low volumes involved and the remote character of these forests.

Equipment and labour costs

Taking into account exclusions enumerated in the preceding article, only the following items have been compiled to establish woody substance costs.

- salaries
- fringe benefits (20% of salaries)
- equipment
- maintenance costs
- surveillance and coordination

It should be observed that daily salaries have been established at 80.00$/day, as agreed with the community representatives and total cost per cubic meter is an average cost for the three communities.

Cutting (felling)

Based on a daily production of 5 m^3 and a salary of 80.00$/per day, cutting costs are 16.00$/solid cubic meter.

Loading and transportation

Based on a daily production of 30 m^3, for an average transportation distance of 10 km[1] and a total salary of 240.00$ for the three forest workers, salaries for this operation are 8.00$ per cubic meter.

Based on the hypothesis stated above, namely that a forest labour crew is in charge of transporting and loading logs converted by 6 wood cutters, the quantity of snowmobiles required for each community is established hereafter for a 40 days hauling period.

(1) This corresponds to the average distance covered by the present study.

TABLE 1.4.1 COST OF HAULING EQUIPMENT

	EASTMAIN	WASKAGANISH	WEMINDJI
Average annual demands	1,180	3,670	2,520
Person days loading	236	734	504
Person days hauling	40	122	84
Snowmobiles	1	3	2
Purchase cost of snowmobile ($)	7,000	21,000	14,000
Purchase cost of sleighs ($) (1)	2,000	6,000	4,000
Cost per solid m^3 ($) (2)	4,96$	5,01$	4,64$

Average cost per solid cubic meter is established at 4,85$. To this cost, must be added maintenance, operation and equipment fees amounting to 4,75$ per solid cubic meter.

Detail is presented hereafter:

Maintenance	2,00$/$m^3$	
Fuel	2,00$/$m^3$	(60L/day at 1,00$/liter)
Lubricant	0,25$/$m^3$	
Licence - insurance	0,50$/$m^3$	

(1) 4 sleighs per snowmobile

(2) The equipment is depreciated over a 2 year period at 14%. This is used as to obtain a conservative evaluation of the cost of wood.

Checking and surveillance

The holder of this title assures the smooth running of operations and, but without being limited to:

- delineates cutting areas as per demand
- assures the availability of the forest workers and equipment.
- controls execution of field operations
- assures maintenance of equipment
- assures quantity of trees felled

and accomplishes all tasks related to management operations, namely preparation of cutting permits according to the M.E.R. Québec requirements and assures that forest fire protection standards are respected, if the case.

Daily rate 100.00$
Period (2 times execution period) 80 days
Average fees for this post is 3,35$/$m^3$ solid.

Cost summary

Summary of harvesting costs is presented hereafter, for an average hauling distance of 10 and 20 km.

Table 1.4.2 Summary of harvesting cost/m^3

($/m^3)

POST	FEES		EXPENSES		TOTAL	
	10 km	20 km	10 km	20 km	10 km	20 km
- Felling	16,00	16,00			16,00	16,00
- Loading & transport	8,00	13,50	9,60	10,75	17,60	24,25
- Checking & surveillance	3,35	3,35			3,35	3,35
- Fringe benefits			5,45	6,60	5,45	6,60
- Miscellaneous (3%)			1,25	1,50	1,25	1,50
TOTAL	27,35$	32,85	16,30$	18,85	43,65$	51,70

The organizational structure

The organizational structure must take into account the simplicity and the small scale of the operations to be performed. A management committee will include representatives of the Cree Band Council, C.R.A., C.H.C. and of other concerned parties. The major responsibility of this committee will be to define annually the wood volumes to be harvested. This annual demand will be based on:

- population growth
- new houses
- houses renovation
- furnace efficiency
- heating habits
- determination of the portion of the residential heating energy demand fulfilled by wood

A supervisor will initiate and control the various operations and will be responsible for harvesting the wood volume determined by the management committee. A summary of his job description was presented previously.

The supervisor will be assisted by one foreman per team work that will be responsible for the day-to-day operations.

Because the operations are spread over a 40 day period, it is recommended that the administration of this organization be assumed by an existing organization, keeping the firewood selling price to a minimum. The organizational structure is presented in table 1.4.3

1.4.2.6 Cost forecasts

Firewood cost includes mainly labour costs. It is supposed that the labour cost will vary in accordance with the general price index. This means the firewood selling price when expressed in constant dollars will remain stable throughout the project.

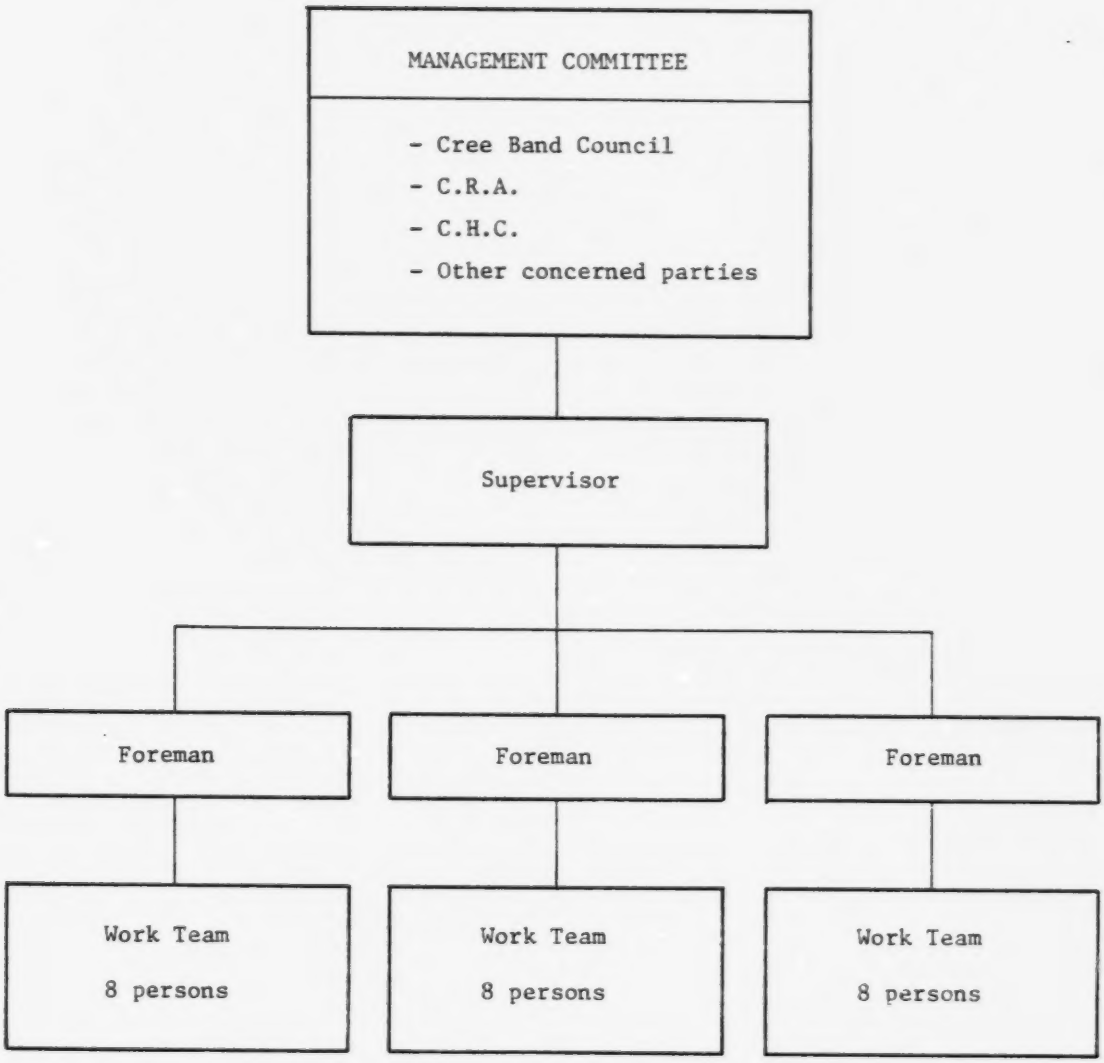
1.4.3 Electricity

For comparison purposes only, this section includes a preliminary estimate of the electricity cost when produced by a mini-hydroelectric power plant. This comparison is valid only in Waskaganish since there is no study for a mini-hydroelectric power plant that could fulfill the heating energy demand for the next thirty years in Eastmain or Wemindji.

Vezina, Fortier et Associés completed a study for a 1.245 MW power plant in Eastmain while Surveyer, Nenniger and Chênevert Inc. (SNC) recommended the construction of a 1.1 MW power plant in Wemindji. This recommendation was accepted and the power plant is presently under construction.

TABLE 1.4.3

ORGANIZATIONAL STRUCTURE



* The number of work teams is a function of the volume to be harvested.

1.4.3.1 Investment costs

Investment costs are derived from the prefeasibility study of mini-hydro potential in the vicinity of Waskaganish realized by ABBDL-TECSULT in 1983. The following costs were estimated:

- access road
- diversion works
- civil works
- turbines and generators
- transmission lines
- indirect costs and contingencies

To these costs are added:

- upgrade of the distributing network
- conversion of the existing heating systems and costs of the furnaces installed in the new houses.

The distributing network capacity will be tripled involving the purchase and installation of twenty-five 100 KVA and ten 50 KVA transformers. The conductors and support elements will not need to be replaced. The total cost of this upgrade is estimated at 130 000$.

The heating power of the electric furnaces is 30 KW and it requires an electrical entry of 200 amperes. The purchase and installation costs are 3 000$ (1) when a new electrical entry is required and 1 450$ when installed in a new house. (2) The total cost of the mini-hydroelectric power plant is 25 630 000$ including the upgrade of the distributing network.

It is assumed that no additional diesel generator is acquired since the existing equipments can fulfill the basic electrical needs in case of a major breakdown. The wood furnaces will provide the heating energy required during the breakdown.

1.4.3.2 Operating costs

The operating and maintenance costs are 20$/kw/year. To this cost will be added the costs associated with the operation and maintenance of the diesel generators. It is assumed that the diesel generators will provide 1% of the energy required. The diesel cost is equal to the heating oil cost and the operation and maintenance costs are 0.25$/KWh.

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(1) Estimated by ABBDL, a Chromalox unit, model HAF 330 D
(2) Estimated by ABBDL

1.4.3.3 Levelized unit energy cost

In order to compare the cost of an all-electricity scenario with the oil and wood scenarios, it is necessary to define which portion of the investments and operation and maintenance costs defined in 1.4.3.1 and 1.4.3.2 have to be allocated to the residential heating energy consumption.

To do this, COGESULT adopted a methodology which is generally accepted by energy economists in evaluating the economics of nuclear power stations. This methodology allows the calculation of a levelized unit energy cost (LUEC). " The LUEC is defined as the unit cost of energy which could be charged each and every year of the operating life time of a plant such that the present worth of the resulting revenue generated would exactly match the present worth of the costs over the same life time". (1) The LUEC is expressed in $/KWh and includes reimbursement of the capital, interests to be paid and operation and maintenance costs. It is assumed the capital is totally borrowed. The annual costs and the electricity produced are discounted to the start of the operations at a real rate of 6%. For Waskaganish, the LUEC is .218$/KWh.

Having evaluated this LUEC, it is possible to estimate annually the cost of the residential heating when electricity produced by a mini-dam is used. For example, in 1984, the heating cost will be:

3 344 000 KWh x .218/KWh = 728 992$

The total annual costs for the following thirty years will be discounted at 6% (as for the other scenarios) and their sum will be the present worth of this option.

1.5 Heating equipment cost

A survey of the existing heating equipment used by the Cree communities was made in order to evaluate their:

- power
- life cycle
- conditions
- general characteristics

The following assumptions are derived from this survey.

(1) Methodology on the economics of CANDU, Atomic Energy of Canada Limited, Draft, August 1982

It is supposed that all houses built since 1975 are equipped with a central warm-air heating system using an oil burner. The furnaces heating power is 120 000 BTU or 35 KW. Their life cycle is 20 years.

Most of the houses built before 1982 are also equipped with a wood stove. The houses built since 1983 are equipped with a wood furnace connected with the oil furnace. The life cycle of the wood furnaces is also twenty years.

It is assumed that oil furnaces will be replaced after twenty years. The average age of the oil furnaces in cedar and white houses is assumed to be six years while the furnaces in model 1 and 11 are 2 years old. The purchase cost is 800$ [1] in Montreal. The transportation cost is 275$ [2] and the installation cost is 525$ for a total cost of 1 600$ per unit.

In the scenarios including firewood utilization, white and cedar houses will be equipped with a wood furnace connected to the central warm-air system. The cost of the furnace in Montreal is 650$ [3] and 1 450$ once installed in the Cree communities.

The wood chips scenario includes the purchase of the following equipment for each house:

- fuel storage bins	=	450$
- gravity feed burner	=	3 550$
Total	=	4 000$

These costs include transportation and installation and are derived from a preliminary budget for the "Domestic Wood Chip Furnace Demonstration" program which is realized by Island Energy Associates Limited for the Department of Mines and Energy of the Government of Newfoundland and Labrador.

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1. Metroheat Inc., model LA 123
2. Based on a .45$/lb. rate
3. Metroheat Inc., model MW 300

2. COMPARATIVE ANALYSIS OF THE SCENARIOS' COSTS

2.1 Scenarios

A distinct economic analysis is made for each community based on the study of eight different heating scenarios.

. Reference scenario

The main assumption in this scenario is to keep the actual proportion of wood and oil used for heating in each community unchanged for the next thirty years.

. 100% oil scenario

No wood is used for heating and new houses are only equipped with an oil furnace

. 75% oil - 25% wood scenario
. 50% oil - 50% wood scenario
. 25% oil - 75% wood scenario

In these scenarios, the new houses are equipped with oil and wood furnaces. The wood stoves in the older houses will be replaced by a wood furnace. The maintenance costs are also doubled since they have two distinct furnaces.

. 100% wood scenario

The new houses are only equipped with wood furnaces. Wood stoves in the older houses are replaced by a wood furnace. No maintenance is provided for existing oil furnaces.

. 100% wood chips scenario

This scenario includes a preliminary cost estimate of the utilization of a wood chips furnace rather than the traditional wood log furnace.

. 100% electricity scenario

This scenario is only valid for Waskaganish. The electricity is provided by a mini-hydroelectric power plant of 5.7 MW. As defined in section 1.4.3.3, a proportion of the investment costs is included.

2.2 Methodology

Costs are expressed in constant 1984 dollars. All the costs related to a scenario are discounted to 1984 in order to calculate the

present worth of the heating costs. This present worth represents the real cost of adopting an heating scenario for the next thirty years. No revenue or return on the investment is incoporated in these calculations.

The discount rate is expressed in real terms, i.e. without inflation. The discount rate is based on the cost of the borrowed capital less the long term inflation expectations. Cost of capital is supposed equivalent to the cost of bonds financing for the federal government (13% in May 1984). The long term inflation expectation is assumed to be 6.5% as mentioned in section 1.4.1. The discount rate is consequently around 6% according to the following calculation:

$$\frac{\text{nominal rate}}{\text{inflation rate}} = \frac{(1 + .13)}{(1 + .065)} = 6\%$$

The annual costs considered are listed below:

- equipment
- energy required
- maintenance
- construction (mini-hydro)
- engineering (mini-hydro)

Maintenance cost of oil and wood furnaces is estimated at 100$[1] per year and per furnace. Maintenance for the electric furnaces is considered negligible. The other costs were previously defined in the previous sections.

From a financial standpoint, the scenario with the lowest present value of the annual cost represents the option requiring the minimum cash outlays over the next thirty years. Detailed calculations are found in appendix 9.

2.3 Cost comparison

. 100% electricity

The present worth of the scenarios are presented in table 2.3.1. The most expensive scenario is the 100% electricity scenario with a present worth of 13 825 600$. This present worth is very high owing to the important investment costs which are reflected in the calculated levelized unit energy cost (section 1.4.3.3).

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(1) Based on a maintenance contract offered by Texaco Canada Ltd in Montreal to which is added a distance premium of 33% = 75$/year x 1.33 = 100$

TABLE 2.3.1

PRESENT WORTH OF THE RESIDENTIAL HEATING SCENARIOS

(x.000$)

Scenarios / communities	100% oil	75% oil 25% wood	50% oil 50% wood	25% oil 75% wood	100% wood	100% wood chips	100% electricity	Actual 84
Waskaganish	6217.7	5970.4	5097.7	4220.5	2780.4	2802.9	13 825.6	5652.6
Eastmain	2271.7	2204.0	1870.0	1533.5	953.8	1105.3	-	1533.5
Wemindji	4815.2	4655.3	3978.5	3299.0	2124.3	2119.8	-	3299.0

. 100% oil

Oil heating cost is about half the electric heating cost with a present worth of 6 217 700$ for Waskaganish, 2 271 700$ for Eastmain and 4 915 200$ for Wemindji.

. 100% wood

Finally, wood heating can reduce the heating bill by 55% when compared to oil heating. The present worth of wood heating is 2 780 400$ for Waskaganish, 953 800$ for Eastmain and 2 124 300$ for Wemindji.

. 100% wood chips

The present worth is slightly higher than wood in logs when wood chips are used. It is estimated at 2 802 900$, 1 105 300$ and 2 119 800$ for Waskaganish, Eastmain and Wemindji.

The pros and cons of this new technology are presented in appendix 5. The present study demonstrates the economic feasibility of this process and confirms that the technical questions presented in the appendix 5 are still to be answered.

It may be of interest to keep a close eye on the evolution of this technology and to eventually, compare it again with the furnaces using firewood logs when this technology will have reached a more advanced feasibility level in remote northern communities.

. 75% oil - 25% wood
. 50% oil - 50% wood
. 25% oil - 75% wood

For various considerations, it is possible to use oil and wood in a complementary mode. The present worth of the scenarios varies according to the quantity of oil used. The present worth of the 75% oil-25% wood scenario is only 4% inferior (a difference of 247 300$ in Waskaganish) to the 100% oil scenario because of the purchase and maintenance costs associated with the operation of two furnaces per house. For the same reasons, the 100% wood scenario allows significant savings of 35% (a difference of 1 174 700$ in Wemindji) when compared with the 75% wood - 25% oil scenario.

. Reference case

The 100% wood heating scenario allows savings of 2 872 200$, 579 700$ and 1 174 700$ for Waskaganish, Eastmain and Wemindji when compared to their respective reference scenario. Waskaganish's savings are more important because they actually use a larger proportion of oil to fulfill their heating needs.

3. CONCLUSION AND RECOMMENDATIONS

The results of the present study indicates that wood represents an economical source of energy for heating purpose in the residential sector which can allow savings up to 55% when compared with oil heating.

Furthermore wood heating could create jobs in each community if the Cree communities decide to manage the wood supply through a commercial organization. The harvesting, transportation and distribution of the firewood would create seasonal jobs.

Finally, wood heating will potentially give access to various governmental programs as the COSP program of the Renewable Energy Division of EMR Canada which is aimed at encouraging people to use alternative energy sources. Moreover this wood project could potentially receive some help from the job creation programs of the federal government.

It is however important to not disregard the social impacts associated with wood heating. The conclusions of the social study are clear: nobody seems to favour the 100% wood heating scenario. Its lack of flexibility due to the manual feeding of the furnace implies the addition of a complementary heating system, namely an oil furnace. This reduces significantly the savings potential offered by the firewood utilization but no better solution is presently available.

COGESULT consequently recommends the adoption of the 25% oil - 75% firewood scenario. Installation of dual oil-wood furnaces in every renovated and new houses is necessary and a communal approach for wood harvesting should be organized so as to optimize the harvesting and make firewood available for everybody. More information on wood heating should be provided through various information sessions.

4. BIBLIOGRAPHY

1. ABBDL-TECSULT, "Prefeasibility study of mini-hydro potential in the vicinity of Waskaganish", October 1983.

2. Atomic Energy of Canada Limited, "Methodology on the economics of CANDU, a draft", August 1982.

3. Daniel Arbour & Associés, "Housing and Infrastructure Program, 1983 Planning Report", October 1983.

4. Energy, Mines and Resources, Canada, "Les systèmes de chauffage: guide du consommateur" April 1983, 87 pages.

5. Fortin Jacques, S.I.F. du M.E.R. Quebec, "La croissance forestière au Québec, October 1983.

6. Ministère Energie et Ressources, Quebec, "Guide d'aménagement du milieu forestier", 1977, 158 pages.

7. Ministère Energie et Ressources, Québec, Groupe de planification sectorielle, "Guide de l'aménagement du milieu forestier", June 1977, 158 pages.

8. Ministère du Loisir, de la chasse et de la pêche, Québec, Direction générale de la faune, " La protection des habitats fauniques au Québec," April 1983, 173 pages.

APPENDIX 1 - HEATING ENERGY CONSUMPTION

INTRODUCTION

The heating energy consumption of a house is basically defined as the difference between the thermal losses and the internal and passive solar contributions. Thermal losses come from two sources:

- the housing
- the air change

Thermal losses issued from the housing is evaluated by measuring the thermal resistance of the various elements constituting the housing (windows, doors, walls,...). Thermal losses coming from air change are the consequence of:

- mechanical ventilation - kitchen and bathroom
- In model 1, an air inlet well insulated and connected to the central warm-air heating system.
- accidental ventilation by doors and windows. Sliding windows are not very air tight.
- many incomings and outgoings
- light infiltration at the junction of the wood frame and the foundation.
- light infiltration at the vents level.

The air change is expressed as a rate per hour. The thermal losses caused by the air change is calculated as following:

(Habitable volume) x (air thermal capacity) x (air change rate per hour)

Finally, the average annual degree - days are taken into account to determine the gross thermal losses.

The internal contributions are listed below:

people contributions

- average persons/house = 6
- occupancy rate = 12 hours/day
- calorific capacity = 100 W/person

People contributions = 6 x 12 x 180 x 0.1 KW = 1300 KWh

electric appliances:

- Freezer = 600 KWh
- Oven = 450 KWh
- Refrigerator = 350 KWh
- Stove = 100 KWh
- Others = 500 KWh

Total = 4000 KWh

The evaluation of the solar contributions takes into account the random character of the houses orientation and their windows distribution and design, an average orientation value is utilized: south, south-east, south-west, west and east. According to the sunshine data available for these regions and the usual weakening factors associated with solar contribution, we obtain:

$6\ m^2 \times 380\ KW = 2280\ KWh$

The heating energy consumption is then evaluated as the gross thermal loses minus the internal and solar contributions.

1. Model 1

Coefficient of heat loss from the housing: G1

Building components	Area (S) (m^2)	Thermal resistance (R) (m^2 °C/W)	S/R (W/°C)
Ceilings	86,4	7	12,3
Exposed walls	121,5	4,5	27,0
Doors	3,1	1,2	2,5
Foundations (concrete)			
exposed portion	6,0	3,0	2,0
60 cm below the			
ground level	23,0	3,0	7,0
the balance	23,0	3,0	5,0
Basement floor			
periphery	36,4	0,25	4,0
center	50,0	0,25	3,0
Windows facing			
south	5,7	0,32	18,0
north	3,76	0,32	12,0
east	1,08	0,32	3,3
west	0,0	0,32	0,0

G1 = total = 96,0 W/°C

Coefficient of heat loss from the air change: G2

An air change coefficient of 0.5 times the habitable volume seems to be appropriate. This estimation is confirmed by the relative humidity table when the following data are used:

- 40% relative humidity at 21°C
- production of 15 to 20 kilograms of steam per day per house.

Habitable volume: $432\ m^3$
Air thermal capacity: $0{,}34\ \frac{m^3}{}$ /°C
Air change rate per hour: 0,5
Heat loss coefficient G2 = 0,34 x 432 x 0.5 = 73

Global heat loss coefficient: G

G = G1 + G2 = 96 + 73 = 169 W/°C

Average annuel degree - days (DD) = 7 200 °C

Gross thermal losses

$$G \times 24 \times DD = \frac{169 \times 24 \times 7\,200}{1000} = 29\,000 \text{ KWh}$$

*

with adjusted degree - days = 27 000 KWh

Internal contributions = 4000 KWh
Solar contributions = 2280 KWh

Total contributions = 6280 KWh

Net thermal losses = 27000 KWh - 6280 KWh = 20720 KWh

The average annual heating energy consumption for model 1 house is: 20 720 KWh.

* The reference temperature is 18 °C. An adjustment is necessary to take into account the average temperature, deducted from temperatures of basement and the rest of the house and from the balance between nights and day temperature. The result is a reference temperature of 16,6 °C (18 - 16,6 °C) x 365 jours x 24 h/j x .169 w/°C = 2072 KWh

2. Model 11

Coefficient of heat loss from the housing: G1

Building components	Area (S) (m^2)	Thermal resistance (R) (m^2 °C/W)	S/R (W/°C)
Ceilings	107	7	15.3
Exposed walls	237	4.5	52.6
Doors	6	1.2	5
Foundations			
exposed portion	11	3	3.6
60 cm below ground level	26	3	8.0
the balance	35	3	7.6
basement floor			
periphery	41.5	.25	5.0
center	63	.25	4.0
windows facing			
south	14.5	.32	45.3
north	12.5	.32	39.0
east	0	0	0
west	0	0	0

G1 = Total = 185 W/°C

Coefficient of heat loss from the air change: G2

Same conditions as for model 1.

Habitable volume = 395 m^3/unit x 2 = 790 m^3

G2 = 0.34 x 790 x 0.5 = 134 W/°C

Global heat loss coefficient: G

G = G1 + G2 = 185 + 134 = 319 W/°C or 159.5 W/°C/unit

Gross thermal losses

$$G \times 24 \times DD = \frac{159.5 \times 24 \times 7200}{1000} = 27\ 560 \text{ KWh}$$

with adjusted degree - days = 26 400 KWh

Total contributions = 6600 KWh

Net thermal losses = 26400 KWh - 6600 KWh = 19800 KWh

The average annual heating energy consumption for model 11 house is: 19 800 KWh.

3. White houses not renovated

Small differences were noted depending on the construction date. They always have a basement and most of them are located in Waskaganish. The foundations are made from treated wood (Domtar process) or concrete. The insulation is either inside or outside. Insulating materials for the roof may differ but their insulating capacity as well as their air tightness are very similar. An average value will consequently be used.

Coefficient of heat loss from the housing: G1

Building components	Area (S) (m^2)	Thermal resistance (R) (m^2°C/W)	S/R (W/°C)
Ceilings	74	4	18.5
Exposed walls	70.4	2.5	28.0
Doors	3.6	0.7	5.1
Foundations			
exposed portion	30.0	2.2	13.5
hidden portion	51.0	2.2	80.0
Basement floor	74.0	0.2	8.0
Windows	11.0	0.3	36.7

G1 = 130 W/°C

Coefficient of heat loss from the air change: G2

Habitable volume = 370 m^3

Air change rate = 0.6

G2 = 0.34 x 370 x 0.6 = 75 W/°C

G = G1 + G2 = 75 + 130 = 205 W/°C = 0.205 KW/°C

Gross thermal losses

G x 24 x DD = 0.205 x 24 x 7200 = 35 400 KWh

with adjusted DD = 33 000 KWh

Total contributions = 5 800 KWh

Net thermal losses

33 000 KWh - 5 800 KWh = 27 200 KWh

The average annual heating energy consumption for white houses not renovated is: 27 200 KWh

4. Renovated white houses

Coefficient of heat loss from the housing : G1

Building components	Area (S) (m^2)	Thermal resistance (m^2 °C/W)	S/R (W/°C)
Ceilings	74	6.0	12.4
Exposed walls	70.4	2.5	28.0
Doors	3.6	0.7	5.1
Foundations			
exposed portion	30.0	2.7	11.1
hidden portion	51.0	2.7	18.9
Basement floor	74.0	0.2	8.0
Windows	11.0	0.3	36.5

G1 = 119,0 W/°C
G2 = 75 W/°C

G = G1 + G2 = 119 + 75 = 194 W/°C = 0.194 KW/°C

Gross thermal losses

G x 24 x DD = 0.194 x 24 x 7200 = 33 500 KWh

with adjusted DD = 31 400 KWh

net thermal losses = 25 600 KWh

The average annual heating energy consumption for renovated white house is 25 800 KWh

5. Cedar houses

There are cedar houses with or without habitable basement. The foundations are made from treated wood, concrete blocks or concrete. Insulating materials and facings vary according to the construction date and the communities but present a similar insulating efficiency.

5.1 Cedar houses with habitable basement

Coefficient of heat loss from the housing = G1

Building components	Area (S) (m^2)	Thermal resistance (R) (m^2 °C/W)	S/R (W/°C)
Ceilings	74.0	2.6	28
Exposed walls	70.4	1.75	40.2
Doors	3.6	0.5	7.2
Foundations			
exposed portion	25.0	1.55	19.3
hidden portion	55.0	1.55	18
Basement floor	74.0	0.2	8
Windows	11.0	0.3	36.6

G1 = 157 W/°C

Due to the low level of air tightness, an air change coefficient of 0.7 is adopted.

Habitable volume = 370 m^3

G2 = 0.34 x 370 x 0.7 = 88 W/°C

G = G1 + G2 = 157 + 88 = 245 W/°C = 0.245 KW/°C

Gross thermal losses

G x 24 x DD = 0.245 x 24 x 7200 = 42 300 KWh

with adjusted DD = 37 000 KWh

Net thermal losses = 37 000 KWh - 6600 KWh = 30 400 KWh

The average annual heating energy for cedar houses with habitable basement is 30 400 KWh

5.2 Renovated cedar houses

Coefficient of heat loss from air change = G1

Building components	Area (S) (m^2)	Thermal resistance (R) (m^2°C/W)	S/R (W/°C)
Ceilings	74	5.4	13.7
Exposed walls	70.4	3.4	20.7
Doors	3.6	0.7	5.1
Foundations			
exposed portion	30.0	2.8	10.7
hidden portion	51.0	2.8	10.2
Basement floor	74.0	0.2	8.0
Windows	11.0	0.3	36.6

G1 = 104.7 W/°C

G2 = 0.34 x 370 x .55 = 70 W/°C

G = G1 + G2 = 104.7 + 70 = 174.7 W/°C = 0.1747 KW/°C

Gross thermal losses

G x 24 x DD = 0.1747 x 24 x 7200 = 30188 KWh

with adjusted DD = 29000 KWh

Net thermal losses = 29 000 KWh - 6600 KWh = 22 400 KWh

The average annual heating energy consumption for renovated cedar house is: 22 400 KWh

5.3 Cedar houses without finished basement

Coefficient of heat loss from air change = G1

Building components	Area (S) (m^2)	Thermal resistance (R) (m^2°C/W)	S/R (W/°C)
Ceilings	74	2.6	28.0
Exposed walls	70.4	1.75	40.2
Doors	3.2	0.5	6.4
Foundations			
exposed portion	24.5	1.55	11.6
hidden portion	15.0	1.55	5.0
Basement floor	74.0	-	3.0
Windows	10.0	0.3	33.6

G1 = 131.6 W/°C

Habitable volume = 250 m^3

G2 = 0.34 x 250 x 0.7 = 60 W/°C
G = G1 + G2 = 131.6 + 60 = 191.6 W/°C = 0.1916 KW/°C

Gross thermal losses

0.191 x 24 x 7 200 = 33 100 KWh
with adjusted DD = 31 000 KWh

Net thermal losses = 31 000 - 6000 = 25 000 KWh

The average annual heating energy requirements for cedar house without finished basement is: 25 000 KWh

After renovation, G1 = 93 W/°C

G2 = 0.34 x 250 x 0.55 = 0.14 KW/°C

Gross thermal losses = 0.14 x 24 x 7 200 = 24 200 KWh
Net thermal losses = 24 200 KWh - 6000 KWh = 18 200 KWh

The average annual heating energy requirements for renovated cedar house without finished basement is: 18 200 KWh

6. New models

6.1 Model "45"

(24' x 26') - Two habitable levels
- Two semi-detached units

Coefficient of heat loss from air change = G1

Building components	Area (S) (m^2)	Thermal resistance (R) (m^2 °C/W)	S/R (W/°C)
Ceilings	116	7.0	16.5
Exposed walls	175	4.4	40.0
Doors	7.2	1.0	7.2
Hidden foundations	65	3.0	16.0
Basement floor	116	0.4	9.0
Windows	15	0.35	43

G1 = 132 W/°C

G2 = 0.34 x 580 x 0.5 = 98 W/°C

G = G1 + G2 = 132 + 98 = 230 W/°C = 0.230 KW/°C

Gross thermal losses = 0.230 x 7200 x 24 = 39 744 KWh

Net thermal losses = 39 744 - 11 600 = 28 144 KWh

Net thermal losses per unit = 14072 KWh

The average annual heating energy requirements for model 45 houses is: 14 072 KWh

6.2 Model "21"

(24' x 32') = Two habitable levels
Two semi-detached units

Coefficient of heat loss from air change = G1

Building components	Area (S) (m^2)	Thermal resistance (R) (m^2 °C/W)	S/R (W/°C)
Ceiling	142	7	20.2
Exposed walls	178	4.5	39.5
Doors	7.2	1	7.2
Hidden foundations	67.5	3.0	17
Basement floor	142	0.4	9
Windows	15	0.35	43

G1 = 136 W/°C

G2 = 0.34 x 710 x 0.5 = 120 W/°C

G = G1 + G2 = 136 + 120 = 256 W/°C = 0.256 KW/°C

Gross thermal losses

0.256 x 7 200 x 24 = 44 237 KWh

Net thermal losses = 44 237 - 12 200 = 32 037 KWh

Net thermal losses per unit = 16 000 KWh

The average annual heating energy consumption for model 21 house is: 16 000 KWh

APPENDIX 2 - AVAILABILITY OF FUEL

1. Photo-Interpretation of the Area

1.1 Scale of Aerial Photographs

Potential yield survey is obtained by photo-interpretation of the area. This interprertation was carried out by using available aerial photographs for each community.

For the territories in category 1A, included in the sectors under study, the interpretation was carried out by using aerial photographs taken by Regional Lands Directorate, Environment Canada, at scale 1:20 000, dated 1982 and 1983. For the other, interpretation was undertaken by using aerial photographs from the Ministère de l'Energie et des Ressources du Québec, at scale 1:15 840 and 1:31680 and dated 1968 and 1964 respectively.

COMMUNITY	PHOTO SCALE	YEAR OF PHOTO
Waskaganish	1: 20 000	1983
	1: 15 840	1968
Eastmain	1: 20 000	1983
	1: 15 840	1964
Wemindji	1: 20 000	1982
	1: 31 680	1964

1.2 Up-Dating of Aerial Photographs

Up-dating of these photographs was made by helicopter survey prior to sampling work. All major perturbations (forest fires, blow-down and forest logging zones) were also updated in order to avoid over-estimating potential yield.

1.3 Stratification of the Area

Photo-interpretation was carried out in conformity with standards presently in force at the Ministère de l'Energie et des Ressources du Québec and the description of strata was based on the following criteria.

- forest cover type
- origin of stand
- average density (class)
- average height (class)
- main species
- disturbance factors
- etc.

A detailed description of these criteria is shown on the maps herewith.

In order to assure the relevance of aerial photographs taken in 1964 and 1968, these parameters were also updated.

This updating was carried out during final interpretation of aerial photographs; it consisted in updating, following sampling results, the preliminary interpretation made in cabinet prior to field work.

2. Field Sampling

A forest stand evaluation requires a yield table which is obtained by a forest inventory.

Since no recent inventory for the project area is available at the Ministère de l'Energie et des Ressources Québec, we have included, for data accuracy purposes, a wood sample study taken in the periphery of each of the three communities.

This sampling was carried out within the study sectors for each community and 148 sample plots were measured.

COMMUNITY	NUMBER OF PLOTS
Waskaganish	50
Eastmain	49
Wemindji	49

2.1 Boring Plan

Operations, which serve to determine the fraction of forest land to be sampled and to set sampling distribution mode, make up the boring plan.

This boring plan was carried out in cabinet, using results obtained from the preliminary interpretation of aerial photographs. Thus, as stated beforehand, 148 parcels were distributed on the territory, permitting a 10% precision in the estimation of the total yield, at a probability level of 95%.

2.2 Sampling

Sampling was carried out by using rectangular sample plots of 1/50 hectare. Within each of these plots, all the stems 9 cm and over in diameter at breast height (D.B.H.) have been measured. Stems from 1 to 9 cm at D.B.H. have been measured within the first five meters of the plots.

2.3 Tree Study Data

No tree studies were carried out during sampling in order to collect data for establishing a volume table. Volume tables obtained from the M.E.R., Eastmain Region, were used.

3. Compilation of Inventory Work

The evaluation of forest stands by means of forest inventory will bring compilation of all data collected, mainly in view of a precise estimation of the woody substance volumes.

The preparation of stand and yield tables will serve as a basis for the definition of the stand volume of the various stands sampled.

These tables, which provide respectively the number of stems per hectare and the volume per hectare for each stratum, will be used as basis for the determination of potential sustained yield and the most advantageous harvesting areas.

Four phases of compilation are necessary for a precise compilation of collected data, they are:

- Elaboration of local volume table
- Regrouping of strata
- Production of stand tables
- Production of stock tables

These compilation phases are given in detail hereafter.

3.1 Local Volume Tables

The local volume table gives the mean volume per species and per class of diameter for a given territory.

In this case, and as mentioned in item 1.2.3, volume tables used derive from tree studies carried out by the M.E.R. in the Eastmain Region. These are in fact volume tables in force at the M.E.R. for that region and were published in 1981 by "Le Service de l'Inventaire forestier (S.I.F.) (ref: TC 70027 Eastmain zone).

Species identified in the field are listed below:

Table 3.1.1 LIST OF SPECIES IDENTIFIED

RESINOUS		LEAFY	
Balsam fir	Sab	Balsam Poplar	Peb
White spruce	Epb	Trembling Poplar	Pet
Black spruce	Epn		
Jack pine	Pig		
Tamarac	Mel		

3.2 Regrouping of Strata

Sample plots carried out during the forest inventory served as basic data for the regrouping of strata.

When compiling results, each sample plot realized during the inventory cannot be considered as an entity.

After studying the results of the forest inventory, it was established that certain forest strata were not sampled or were sampled with insufficient number of plots; we must then regroup certain plots in order to obtain desired precision.

Each sample plot for the three communities was relocated on the maps following the interpretation of the said territory and then, plots having the same cartographic denomination, were regrouped.

These 148 plots were regrouped under 10 different cartographic denomination.

In the first regrouping, strata with insufficient sampling were paired with more representative ones; in the second, strata were regrouped as per cover types (resinous, mixed or leafy), species, height-density class, as well as per mean volume per hectare.

Strata not sampled while stock taking were subsequently regrouped on the same criteria.

TABLE 3.2.1 REGROUPING OF STRATA

REGROUPING	Nb OF PLOTS	CARTOGRAPHIC STRATA	Nb OF PLOTS	AREA (ha)
E B3 120	30	E A3 90	0	17
		E A3 120	3	143
		E B3 120	27	3 911
		E B3 90	0	4
		E B2 120	0	326
				4 401
E C3 120	48	E C2 120	0	258
		E C3 120	48	11 948
		E C3 120 cp	0	4
		Me C3 120	0	11
		E C3 70	0	13
		E C2 120 chp	0	34
		E C3 120 chp	0	45
		E C2 120 chp	0	373
				12 686
E D3 120	33	E D2 120	0	5
		E D3 120	33	8 186
		E D3 90	0	31
		E (Me) D3 90	0	17
		E D3 120 brp	0	40
		E D2 120 chp	0	28
		E D3 120 cp	0	34
		E D3 120 chp	0	192
				8 533
E B4 120	7	E B4 120	7	256
		E B4 90	0	28
		Me B4 120	0	16
		E B4 50	0	5
				305
E C4 120	15	E C4 120	15	4 284
		Me C4 120	0	71
		E C4 50	0	171
		E C4 70	0	52
				4 578

TABLE 3.2.1 REGROUPING OF STRATA (Cont'd)

E D4 120	10	E D4 120	7	4 494
		E D3 120 cp	3	174
		E D4 120 cp	0	3
		E D4 70	0	22
				4 693
Tr C3 90	5	Tr C3 90	4	27
		Tr B3 90	0	4
		Tr D3 90	0	6
		Tr C3 120	0	2
		Tr C2 90	1	5
		Tr C2 90 cp	0	10
		Tr B2 90	0	45
		Tr C2 70	0	7
		Tr D2 90	0	42
		Tr D3 70 chp	0	4
				152
Pg C4 (*)	0	Pg C4 120	0	61
Pg D4 (*)	0	Pg D4 120	0	24
BbRR C4 (*)	0	Tr R C2 120	0	15
		Tr R C2 90	0	41
		Tr R D2 90	0	57
		Tr R C3 90	0	53
		Tr R B3 120	0	2
		Tr R C3 120	0	7
		Tr R D3 70-120	0	17
		FIR C3 90	0	78
		FIR C3 120	0	61
		FIR B4 90	0	27
		FIR C3 120 cp	0	32
		Tr R C2 120 chp	0	50
		Tr R C3 90 chp	0	26
		Tr R B2 90	0	27
		Tr R C2 90	0	69
		FIR D3 90	0	25
		FIR B3 90	0	12
		FIR D3 70	0	15
				699
Regenaration forest	-	CT	-	230
		br	-	1 910
		Rrbr	-	786
		Cht	-	255

TABLE 3.2.1 REGROUPING OF STRATA (Cont'd)

Unproductive forest	-	Base humid	-	54 607
		Base dry	-	20 272
		alder-grove	-	1 522
Non-forest	-		-	271
TOTAL	148		148	115 900

(*) M.E.R. Data

However, a few secondary strata whose total area represent less than 1% of the project area could not be regrouped as per these criteria. For these, data from the M.E.R., Eastmain zone, were used.

Finally, the ten (10) strata sampled in the field by the bias of one hundred and fourty-height (148) sample plots, were regrouped in seven (7) forest strata. The few secondary strata that could not be regrouped as per established criteria were regrouped under three distinct names. Strata regrouping is shown hereafter.

3.3 Stand Tables

Stand tables give the distribution of stems per hectare, per species and per class of diameter for each of the preceding regrouped strata.

Sample plots combined to form each regrouped strata serve as basic data to establish stand tables.

The method consists in redistributing, for a unit area of 1 hectare, the number of stems per species and per class of diameter of sample plots in one strata.

Stand tables for each regrouped strata are given in appendix 8

3.4 Stock tables

Stock tables give the total yield in cubic meters per hectare, per species and per diameter class for each regrouped strata. The volume tables as well as the stand tables serve as a calculation basis to establish stock tables. These derive from the product, per species and per diameter class, of the stock and volume tables.

Stock tables giving total yield per hectare are presented in Appendix 7.

4. Cartography

4.1 Base Maps

In order to determine the woody substance volume, forest maps are the essential complement of data compilations. As there were no pertinent base maps to transfer photo-interpretation results, base maps were drawn for each community from topographic maps at scale 1 :50 000 published by "Le Ministère de l'Energie , des Mines et des Ressource du Canada".

The latter were enlarged at scale 1 :20 000 and redrawn keeping only project sectors without, however, being systematically limited to them. In general, these maps cover a much larger territory than the project sectors.

4.2 Forest Mapping

Once the photo-interpretation and the field sampling survey were completed, the information was transferred on the 1:20 000 base maps. These maps will then be used to localize woody substance concentrations within logging zones marked off for the communities.

The maps are presented in Appendix, for each community.

5. Total yield

Total yield corresponds to total volume of all commercial stems 10 cm and more at D.B.H., without taking into account utilization and various wastes. This is obtained by the volume product given in the stock tables for regrouped strata shown in appendix 7 and its corresponding area.

5.1 Planimetry

The grid method was used for area classification, which was then regrouped as to its given land category (Yield Table). This stratification divides forest from non-forest land and regroups them as to their development stage. This stratification will be most important by the determination of its annual yield.

The yield table is presented in table 5.1.1 for each community. Note that water courses and lake areas were not compiled in this table.

- Non-forest Land

Land not primarily intended for growing or not supporting forest which, have been conferred by man, a vocation other than forest land.

Ex: Airport, gravel pits, roads, etc.

- Forest land

Land primarily intended for growing or currently supporting forest producing woody substance if mainly used for that purpose.

TABLE 5.1.1 YIELD TABLE (ha)

COMMUNITY / LAND CATEGORY	AREA					
	WASKAGANISH		EASTMAIN		WEMINDJI	
	(ha)	(%)	(ha)	(%)	(ha)	(%)
NON-FOREST LAND	157	0,4	66	0,2	48	0,1
FOREST LAND	43 443	99,6	27 434	99,8	44 752	99,9
. unproductive	31 365	71,9	17 764	64,6	27 272	60,9
. productive	12 078	27,7	9 670	35,2	17 480	39,0
- Young & Mature	11 039	25,3	9 149	33,3	15 859	35,4
- Regeneration	187	0,14	219	0,8	393	0,9
- Regenerating	852	2,0	302	1,1	1 228	2,7
TOTAL AREA	43 600	100,0	27 500	100,0	44 800	100,0

Each land category is detailed hereinafter.

- Unproductive Forest Land

All forest land whose yield is lower than 28 m^3/ha.

Ex: Bare/humid, alder-grove, etc.

- Productive forest Land

All forest land whose anticipated yield is higher than 28 m^3/ha.

- Regenerating Stands

Stands regenerating or newly implanted.

Ex: Total cut (Ct), burnt over area (br)

- Regenaration Stands

Stands newly implanted, in full growth, generally without or very little merchantable volume.

Ex: Rrbr

- Young and Mature Stands

Stands whose stems are of merchantable dimension (10 cm at D.B.H.) and who may be logged.

Ex: EC3120, EA390, etc.

The analysis of this table shows that between 60 and 72% of project area is occupied by unproductive forest stands and that only 28 to 40% of total area is capable of yielding productive forest stands. This has a definite influence on the woody substance distribution availability as may be checked in the attached maps. In fact, there is no uniformity in the distribution of the forest cover and important concentration of woody substance are sporadically distributed over the territory.

5.2 Yield

5.2.1 Young and Mature Stands

Project's area available total yield for each community and distribution per species are presented in section 1.2.2.1.

These 2 tables give total yield and per species of young and mature forest stands liable to be exploited for production of woody substance in the framework of producing firewood within limits of forest said to be non commercial.

In a conventional forest context, all these strata, except for EB3120, would eventually be excluded from all felling programs, because of its low yield per hectare and its reduced number of stems.

5.2.2 Vegetation Plots

To the quantities identified for each community, woody substance could be added to volumes originating from vegetation blocks whose area is too small (2 ha) to be cartographied at scale 1:20 000. These blocks, generally located within unproductive forest stands do not, however, show a significant source of fuel in the framework of supplying a community requiring important forest operations. In fact, this type of sporadic intervention brings a cut in labour and machinery productivity and moreover, an increase in production costs.

However, these blocks may represent an interesting source of woody substance able to meet family requirements.

Nevertheless, in the decision process, we must not over-evaluate the importance of these quantities since our final recommendations must not depend on marginal parameters ho could then become out of proportion in this decision process.

For these reasons we have not evaluated these quantities.

5.2.3 Unproductive Forest Stands

Like the vegetation blocks, unproductive forest stands contain a certain woody substance volume which could represent an interesting source of raw material able to meet family requirements.

However, for the same reasons stated beforehand, we have not evaluated these quantities.

5.2.4 Non Merchantable Trees

Trees whose D.B.H. is lower than 9 cm are not calculated in the stock tables. Therefore, various forest strata enumerated in table 4 containing a great number of these stems could eventually be used as fuelwood. (See stand table at Appendix 7).

Depending on the strategy adopted, the forest workers in charge of collecting woody substance, these woods could eventually be recovered.

APPENDIX 3 - FOREST FIRE PROTECTION

FOREST FIRE PROTECTION

The increasing use of wood as fuel to meet energy requirements of the Waskaganish, Eastmain and Wemindji communities will necessarily entail an increase of activities in the vicinity of forests which will contribute to higher risks of forest fires.

In order to reduce such risks and also ensure adequate protection to the members of the surrounding communities, even in case of conflagrations of natural origin, (lightning, etc) different protective measures could be planned in conjunction with the North-West Conservation Society (N.W.C.S.)

In addition to forest fire fighting, several programs are offered by this society, especially in the field of prevention and detection of fires.

The present chapter will define in detail the mandate assigned to conservation societies, considering that this mandate has a direct influence on the nature and costs of services offered, to analyse briefly the past, present and future status of the communities in regard to forest fire protection, considering the actual context and finally to summarize the different programs offered by the societies and the inherent costs.

1. Mandate of Conservation Societies

According to the law concerning public lands and forests (Art. 129.1 and 129.3), forest concessionaires, owners of private forests of at least 810 ha in a single piece and if the Minister thinks fit, any private forest owner of whatever surface area, are in charge through the medium of a forest protection society acknowledged by the Minister, of prevention and extinction of forest fires in their territory.

In fact, seven conservation societies have been created in Quebec for the purpose of ensuring protection of forests called "commercial".

Under this limitation, all the Quebec territory is the object of a prevention, detection and forest-fire fighting program. Effectively, the Quebec Government covers the cost of protection for all territories not provided for in articles 129.1 and 129.3 of the law concerning public lands and forests, with the exception of major towns and cities.

In the limits of commercial forests, costs of protection are shared proportionally to the surface occupied by each of the members and only the costs related to fire extinction are not included in the member's annual contribution.

Beyond the limits of commercial forests, territory users must reach an agreement with the conservation society on the nature and extent of the program to be applied. Users must also pay the total cost of the program elaboration (intervening plan) at their request.

The total cost sharing of these extra-territorial mandates must be the object of an agreement between the users. These annual charges are much higher than those of commercial forest users for the same type of protection.

2. Past and Actual Status of CREE Communities

In theory, CREE communities are not covered by the NWCS protection since they are located outside the limit of commercial forests and there is no formal agreement relative to the protection of these territories.

However, Phase I of the development of La Grande Complex ensured and still does to a certain extent some form of fire protection to these communities since the North-West Conservation Society has been given a mandate by the various organisms involved to ensure the protection of the territory wherever constructions occured and beyond. To this effect, NWCS implemented a complete protection program with patrol aircrafts, water-bombers and all required material stationed near the communities (LG-2, LG-3, EOL).

Effectively, NWCS intervened on several occasions in times, near the CREE communities, when situations became critical.

These interventions were rendered possible by the presence of appropriate equipment and personnel.

However, the diminution of activities on the territory means a reduction of personnel and equipments on site and less protection for the CREE communities.

In fact, at present, there is no aerial surveillance west of the road linking Matagami to LG-2. This territoy is patrolled only when a fire is signalled or thunder strikes a part of it. Besides, it is the only form of protection existing west of the road.

Presently, protection of CREE communities and the cost thereof are ensured by the various organizations associated to the development of the La Grande Complex and by the Ministry of Energy and Resources. The protection depends on the degree of activities on the territory, activities which will go on decreasing according to the present previsions.

3. Future Status of Communities at present

There is no precise program elaborated by the North-West Conservation Society for the period called after S.E.B.J.

What will be the level of protection granted to the territory? Who would cover the expenses relative to this program?

No matter which decisions are taken by the different organisms involved, one can easily conclude that the protection program will be reduced to a strict minimum, which will necessarily reduce both personnel and equipment and consequently reduce the protection ensured to the communities of Waskaganish, Eastmain and Wemindji.

Although the risks of a major conflagration endangering the lives of the communities are minimal, it would be disastrous if a fire destroyed an important part of the forest capital located near one of the community, especially in view of the possible use of wood as a fuel in the future.

To ensure protection of villages and forests, NWCS could prepare on request an intervening plan taking into considerations the present requirements of the communities.

4. Fire Protection Program

The forest fire protection program offered by the conservation societies cover three distinct sectors:

- Prevention;
- Detection (aerial surveillance);
- Fire-fighting.

4.1 Prevention

Prevention covers several aspects emphasizing education, publicity, supervision of industrial activities in forest and weather forecast. These activities are in part under the responsibility of the fire-lookouts assigned to the territory. In this case, a member of the community with appropriate training from NWPS could be working for the Society principally in the summer.

This possibility would reduce the cost of prevention.

4.2 Detection (Aerial surveillance)

This aspect consists mainly in aerial surveillance of the territory by aerial patrols. The frequency of flights would depend on weather conditions and fire risks and would be controlled entirely by NWPS.

4.3 Fire Fighting

This is evidently the final phase of services offered by conservation societies. Inside the commercial forests'limits, forest fires are systematically fought in order to effect preservation. In non-commercial forests, the decision is taken jointly with SWPS and the territory user. Generally, when particular sites (building yard, communities, industrial installations) are not threatened, fires are not fought. They can however, be kept under observation.

This aspect is, with no doubt, the most expensive and most demanding in human resources and equipments. In fact, it is not worth establishing a complete protection program if the means of adequate intervention are not available.

5. Cost and Logistic

It is particularly difficult to determine precisely the cost of forest protection since the future of the period called after S.E.B.J. is unsettled.

The prevention aspect will call for an approximate annual investment of 15 000$ for salary and expenses of a fire-lookout for the three communities.

The detection aspect would represent an investment of about 50 000$ to cover the cost of an aircraft, to which is added the salary of an aerial observer.

Even if we were to exclude the cost of an actual fire-fighting, this aspect necessitates a particularly expensive support organization:

- Communication system;
- Temporary base for shock teams;
- Airport base;
- Shock teams;
- Administrative personnel;
- Fire-fighting equipment in each community;
- etc.

It is evident that the basic structure required to ensure a complete protection program is quite intricate and necessitate considerable investments on the part of the present users of the James Bay territory.

Unless there is a special agreement with the present users or the Ministry of Energy and Resources, the participation of the Cree communities to a complete program of forest protection will necessitate annually expenses in excess of 100 000$, excluding the cost of actual fire fighting.

6. Synthesis and recommendations

Presently, only the Cree communities are protected and not the surrounding forest. This SWPS protection is ensured within the forest potection program subscribed to by the different users of the Bay James territory. Moreover, the costs of interventions by the NWPS were to date covered by the Ministry of Energy and Resources.

However, in the eventuality of a more rational use of the forest as a source of energy, it would be essential to grant a minimal protection to this capital, notably by a prevention program, formation of fire fighters, purchase of special equipments and installation of an adequate communication system.

This is specially important if the Cree communities decided to use wood to fulfill 100% of their residential heating needs.

By assuring a certain autonomy at the forest protection level, this would permit a rapid intervention when time comes, and would represent an insurance for the communities and the forest capital.

Moreover, "la Convention de la Baie James et du Nord Québécois" stipulates that the Communities must suscribe to a forest fire protection program when forestry operations are performed. The protection level to be provided and the cost sharing of such a program should be negociated with MER Québec.

APPENDIX 4 - HEATING OIL PRICE FORECAST

ECONOMIC COUNCIL OF CANADA
HEATING OIL PRICE FORECAST

YEAR	INCREASE (%)
1984	5.1%
1985	5.6%
1986	6.3%
1987	5.0%
1988	5.3%
1989	6.2%
1990	5.4%
1991	5.6%
1992	5.6%
1993	5.4%

APPENDIX 5 - FOREST BIOMASS UTILIZATION

INTRODUCTION

1. GROSS MERCHANTABLE VOLUME - VS - TOTAL MASS

Merchantable stems of resinous trees harvested in Eastern Canada, corresponds to ± 70% of total above ground tree. Mass remaining that is 30% composed of crown and branches, make-up harvesting residues and constitute an immense potential source of energy.

Black spruce is no exception and a recent study confirms this percentage.

Black Spruces Total mass Distribution(1)

	Oven dried mass	Green mass
Total stem	.79	.79
Crown	.21	.21
Merchantable stem (9cm +)	.69	.69
Fiber of merchantable stem	.60	.60
Bark of merchantable stem	.09	.09

Because an important interrelation exists between the stem volume and its mass, it may be concluded that the merchantable portion of the stem represents 70% of the total stem volume (.69).

1.1 Availability of the Biomass

Commercial Size Trees (D.B.H. 9 cm)

In a conventional harvesting of the woody substance, the bark as well as the fibers of merchantable stems are recuperated, representing about 70% of the total mass or total stem volume. Branches and crown representing 30% of the total mass are left on the cutting area. It must not, however, be anticipated that 100% of this additional volume will be recuperated, whichever method is used.

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(1) Ouellet, Denis, For. Eng. "Centre de Recherche Forestières des Laurentides - Communications Personnelles".

(2)
A recent study carried out in the framework of the ENFOR Programme, shows considering various harvesting scenarios, that the recuperation rate residues comprising branches and crown by using the method of harvesting full trees, varies between 40 to 90% with black spruce averaging 70%.

Volume gained by the harvesting method is therefore 30% as compared to the conventional method. The method to establish this percentage is shown in the following table.

TABLE 1.1.1 VOLUME GAINED BY THE METHOD OF HARVESTING FULL TREES

VOLUME	RATE
Recuperated volume (Bard and fiber)	.70
Additional volume recuperated by the full tree method	.21
TOTAL RECUPERATION	.91
$\frac{\text{Recuperated volume full trees (.91)}}{\text{Recuperated volume conventional (.70)}}$	1.30

1.2. Non-comercial size trees (D.B.H. 9 cm)

Stem volumes 9 cm and less, DBH are not computed whilst establishing forest stands volumes per hectare. These stems may, however, represent an interesting additional volume in terms of biomass. However, due to technological and economic factors, potential utilization of these residues is not yet accessible and consequently this additional volume has not been calculated.

(2) Routhier J.G., Darveau Grenier Lussier & Associés, Implications de l'exploitation par arbres entiers pour la récupération de la biomase, 1983, Enfor P-57.

1.3 Available volume

Referring to the volume gained by the harvesting of full trees shown in table 1, annual availability of the woody substance, for the territories understudy, is established at 6 760 m3, 6 500 m3 8 650 m3 for the Waskaganish, Eastmain and Wemindji communities.

TABLE 1.3.1 AVAILABLE ANNUAL VOLUME BY THE METHOD OF HARVESTING FULL TREES

COMMUNITY	VOLUME (m^3)
Waskaganish	6,760
Eastmain	6,500
Wemindji	8,650

2. Possible uses of the biomass

Other than industrial processing of the biomass into energy, to our knowledge there is no other proven domestic system to convert the biomass into wood chip fuel.

2.4 In Canada, many experiences are being carried out namely in Newfoundland[1] and Prince Edward island[2] and eventhough results seem encouraging, various technical aspects must be improved, namely in the optic of using exclusively the woody substance to fill the communities residential energy requirements.

Utilization of the biomass for energetic production namely woodchips is related to various factors:

1. Recuperation of the woody substance
2. Combustion Equipment
3. Combustion Quality
4. Combustion supply (delivery and storage)
5. Cost of combustion

(1) Woodchip Heating Program, Island Energy Associates Ltd.

(2) Program of Demonstration of Conservation and Renewable Energy Technology in P.E.I. woodchip fuel for residential use, prepared by Island Energy Ass. Ltd.

These factors are succinctly analysed hereinafter:

2.4.1 Recuperation of the Biomass

Biomass recuperation in the vicinity of the three communities is not associated with recuperation of harvesting residues but more at harvest[illegible] full trees. This tested method of harvesting is already in force on a large scale in Quebec.

In the present context, this method is less attractive because it requires a high level of mechanization namely for logging, chipping and chip transport.

Mechanization of operations requires among others:

- purchasing of harvesting machinery
- formation of qualified operators
- qualified mechanics
- fuel supplies for machinery on cutting area
- transfer of this machinery on cutting area
- high cost leasing of machinery
- minimum spare parts in stock for each type of machinery
- etc.

If to these elements are added construction and road maintenance (even in winter), required mechanization for the recuperation of the biomass necessitates much more important pre-requisites than the preconized conventional method.

2.4.2 Combustion equipment

Even though a good variety of woodchip stoker or hopper systems exist this equipment is not yet approved in Canada. Furthermore the efficiency of this equipment does not, at first, seems significantly higher than conventional heating systems unless operated under optimal conditions and initial cost is for its part higher.

2.4.3. Combustion quality

Combustion quality is a determining factor in terms of energetic efficiency. In fact, whatever combustion and nature of combustible, the latter must be homogenous enough to assure a uniform and sustained yield of the system.

In the present case, moisture content of combustion and size of woodchips are conclusive.

Green woodchips do not constitute an interesting source of fuel. In addition, chips may not be all dried thus drying system must be used in order to obtain a higher yield than average.

As for as the size of chips, they must be standard to assure a uniform feeding of the system.

2.4.4 Supply (delivery and storage)

Distribution and storage of combustible represent important constraints when using woodchips as fuel for, as contrary to logs, these may not be stocked outside during intense periods of cold if their moisture rate is higher than 30%.

Consequently, regular combustible delivery brings about additional costs, with no consideration being given to, for each residence, the installation costs of a wood chip burner system, however simple it may be. Reduction of the delivery frequency will require a bigger storage capacity and consequently occupation of an important space in the residences, with additional problems encountered when storing this kind of combustible: excessive moisture, heating of chips, and other.

Chip drying could represent a solution to the overall problem. This operation however, would require purchasing of equipment, additional man-power, combustible as source of energy, additional handling and finally a storage bin against bad weather.

2.4.5 Combustible cost

Net cost of fuel is incontestably the predominant advantage of the forest biomass on fossil combustible. Yet, this advantage is not evident if we compare cost of woodchips and logs in a context where forest biomass is no more a by-product of forest exploitation and where a distribution system must be created.

Utilization of the biomass has the advantage of reducing pressures exercised by the users concerning the forest capital, a factor not to be neglected by the Cree Communities.

There are no basis comparison to establish net cost of the biomass for the Waskaganish, Eastmain and Wemindji communities. The latter will therefore be based on estimations of man-power and equipment productivity.

The method retained consists in cutting stems manually, skidding of full trees and chipping to the haul road. Chips will then be carried by dump-trucks to a storage area to subsequently be delivered to each residence.

Estimated cost of this method is based on a productivity of $50m^3$ /day per 3 person team including logging operations, purchase of 50,000$ skidders, depreciated over 5 years at a rate of 14%. and purchase of a 50,000$ chipper depreciated as per same schedule.

Using this method, cost of chips up to the haul road is 25,60/m^3.

To these costs must be added opening and maintenance costs of a winter road, truck transportation cost and delivery cost of chips. For transportation and delivery of chips, equipment has been presumed leased on the premises, prices comparable to those of the S.E.B.J. Cost of transport and delivery has thus been established at 9.20$/$m^3$ for a total cost of 35.00$ /m^3 (85.00$ per cord), which is added to log combustion costs, considering that drying costs are not included in this estimate.

3. Syntheses

Although cost of raw material seems to favour the utilization of woodchips, many questions presently arise pertaining to combustion and feeding systems, combustible itself as well as supply techniques.

In fact, utilization of the forest biomass in order to produce domestic energy is presently carried out essentially on an experimental basis and the few systems in operation in Canada operate at a reduced rate.

4. OTHER USES OF THE FOREST POTENTIAL

At first, because of limited availability of raw material on the outskirts of the communities, the lack of pertinent data to evaluate more objectively the forest capital in the future, and the reduced size of market potential, it would be venturous to promote utilization of the forest capital specialized production.

To these factors additional restrictions associated with raw material will be added such as diameter and shape of stems. In fact, the mean diameter and the volume of stems shown in the next table indicate that raw material does not represent a decisive factor in the production of timber as an example.

table: Resinous stems mean volume and diameter for the three communities.

COMMUNITIES	MEAN DIAMETER (cm)	MEAN VOLUME (m^3)
Waskaganish	14	.073
Eastmain	14	.072
Wemindji	14	.070

Finally, due to remoteness of the communities, there is little other possible use than consuming products within the communities themselves.

The reserves expressed beforehand indicate that no other utilization of the forest potential can be recommended at this time when strictly using financial and commercial criteria. It is however suggested to verify with a more detailed study if other uses of the forest potential could be feasible when social and economic parameters are considered.

This study should include the following elements:

- a market study
- wood demand analysis
- available woody substance analysis
- economic returns for the communities
- subsidies possibilities
- detailed financial analysis
- a cost/benefit analysis at the community level

APPENDIX 6 - REFORESTATION

1. INTRODUCTION

Reafforestation is an important management tool within the commercial forest limits. Beyond this limit, few plantation has been realized. In fact, only the SEBJ in the framework of its renaturalization works of the complexe La Grande has undergone important planting works in that region. However, results on these plantations are only partial since they were only started in 1978.

As stated by M. Jean-Guy Brouillette, forest engineer for "La direction environnement de la S.E.B.J." in a conference in 1980, "reafforestation in a nordic climate still remains a complex and risky operation specially due to difficult climatic conditions and poor soil"(1).

It is without doubt, considering results obtained from the SEBJ since 6 years, that it is possible to assure the survival and the growth of seedlings beyond the 51st parallel.

We most keep in mind the objectives of the SEBJ which were to initiate the reafforestation of disturbed sites, control erosion, planning of lake banks or tributaries and finally improve the esthetic aspect of disturbed sites, but not to produce woody substance for harvesting purposes, whatever the nature may be.

If reafforestation aims essentially at revitalizing disturbed site by a forest exploitation of by natural agents such as fire, based on the SEBJ's expertise, it is evident that in this context results may be satisfactory.

Keeping in mind that reafforestation objectives are to increase woody substance supplies, one must establish the necessity of these works, and make sure said objectives may be achieved and at competitive prices.

2. EVALUATION OF THE NEEDS

In the context where availability of the woody substance is largely sufficient to meet demands for 30 years and even beyond and that only a fraction of annual yield is exploited, there would be no need for artificial stands to increase supply of woody substance.

in fact, considering growing conditions, creation of artificial stands is not, on short term, the ideal solution to meet combustion needs.

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(1) J.G. Brouillette, for Eng. SEBJ, 1980.

However, if it is the wish to assure, on meanterm, a constant forest capital, (or higher for the future), create supply sources near the communities and finally on a longer period, assure a source of combustion for the next 60 to 100 years, creation of artificial stands may then be considered.

In the present context, however only the desire to assure, on meanterm, a constant forest capital could justify the necessity to carry out reafforestation works, taking into account that calculation of annual yield has been based on a sustained yield and as stipulated in one of the premises, woody stock should perpetuate in time. As for other hypothesis expressed earlier, these represented more a choice than a necessity.

In a scenario where natural reproduction after logging is sufficient to assure restoration of natural stands, creation of artificial stands is needless. However, present knowledge of the milieu does not permit to confirm such an hypothesis.

The fact is, natural reproduction after logging may permit only partial restoration of natural stands. Consequently, forest capital would be mortagaged year after year.

The situation would not however be dramatic. For example, in Eastmain, at the end of the 30 year period, only 6% of total yield for the given territory would have been used and this even where woody substance fills 100% of energy demands and natural reproduction is completely deficient. For Waskaganish and Wemindji these percentages are 18% and 9%.

Even though these percentages are much higher for these two communities, it would be premature at this point to arrive at the conclusion that such a realization is a necessity, if various factors are considered that may influence combustible demand and annual availability. In fact, as long as natural reproduction is not analyzed and that clearing effects on residual stem growth (2 to 8 cm) on cutting area is not known, realization of artificial forest stands must not be considered. A component analysis will give now data for yield calculations and thence help establish the necessity of such a project.

Furthermore, the Cree communities being the only users of the forest capital in the whole region, it would eventually be possible to expand woody substance recuperation on a larger scale.

Finally, only productive forest stands were used to determine yield of the territory, whereas wooded lands support a woody substance volume that could eventually be harvested rather than undergoing reafforestation works.

Also, forest stands forming the riparian habitats could be partially harvested to increase availability of woody substance.

Whatever the case, since total woody substance consumption for the next ten (10) years, shown in the following table, is not indicative in terms of total yield of the territory, parameters presented earlier could be analyzed during that 10 years period and at the same time ensure, from results compiled by the SEBJ, pursued objectives.

Table 2.1 Importance of the woody substance consumption for the next 10 years.

Community	demand (m^3)	total yield (m^3)	%
Waskaganish	28 680	623 887	4.6
Eastmain	10 190	600 281	1.7
Wemindji	22 260	798 569	2.8

At this point, necessity of reafforestation works is far from having been determined. Various parameters must be further analyzed and many scenarios could eventually be presented rather than creating artificial stands:

- exploitation of unproductive forest stands;
- exploitation of new cutting areas;
- selective cutting in woodlands kept for protected riparian habitats;
- Other source of combustion (floating wood, etc).

3. POSSIBLE SUCCESS

Even if the necessity of reafforestation works had been clearly established in the preceding chapter, there are no previous precedents permitting to confirm that pursued objectives which are to assure at all times a constant forest capital by creating artificial stands, are met in spite of the SEBJ's realizations.

Works of the SEBJ show without a doubt that seedling planting, even beyond the 51st parallel, accelerates the reafforestation and growth process of disturbed sites. However, little or nothing is known about growth of these seedlings, namely commercial species and their evolution. One component however is sure, not all sites are favorable to plantation and survival of seedlings.

Consequently, experience of the SEBJ tends to demonstrate that sites excessively exposed to winds and for which snow cumulation is insufficient, are not favorable for growth of seedlings and their survival rate is particularly low.

It is also very important to understand that poor growing sites, who naturally do not permit the growth of productive forest stands do not allow unless corrective measures are brought growth of artificial quality stands.

Furthermore, good growing sites who normally favour productive forest stands are not necessarily more favorable to growth of seedlings without prior site preparation activities. This is because of competition of other plants for the soil nutrients and light as well as a thick humus layer which hinders seedling roots penetration.

In fact, to carry out such a program would require a good knowledge of the milieu, specially of soils and growth conditions, which is not the case presently.

If we add to this lack of knowledge of the environment, the persisting uncertainty of future artificial stands development, pursued objectives are far from being evident.

4. NATURE AND SCOPE OF REAFFORESTATION WORKS

If plantation works were carried out on the outskirts of the communities, they should at least conserve a constant forest potential as stated beforehand.

In order to accomplish this, sowing and planting of bare root seedlings are virtually excluded, only container grown seedlings could be conclusive. Naturally, choice of species will depend on natural territorial distribution. Thus, spruce and more particularly white spruce could be planted as well as possibly tamarack and jack pine.

As pursued objective is to assure a constant forest capital and not an extensive forest management, only annually cut over areas could be considered for reafforestation work.

Thus, based on a reafforestation rate that could at maturity be compared to the volume presently produced taking into account an 80% plant survival, the amount of seedlings to be planted for each community would be:

Table 4.1 Required number of seedlings for reafforestation of areas harvested annually.

	Waskaganish	Eastmain	Wemindji
Mean annual demand (m^3)	3 670	1 180	2 520
Mean vol. per stem (m^3)	0,077	.0719	0.086
Total number of stems	47 660	14 940	29 300
Mean amount of stems (ha)	1 095	1 028	866
Area to be reafforested (ha)	43.5	14.5	34.0
Amount of seedlings	85 790	26 900	52 740

For calculation purposes it has been assumed, as stated in section 2, that no plantation would be started for the first 10 years since this period is required to establish the necessity of such a program. These plantations would therefore be carried out on a 20 year period.

Soil preparation (scarifying), plant liberation (mechanical or chemical) and fertilization, could be added to plantation works depending on results obtained following soil analysis and growth conditions.

5. COST OF REAFFORESTATION WORKS

Presently plantation contracts are granted by the Ministry Energy and Resources (M.E.R.) at ten cents per plant.[1] These costs include salaries, expenses as well as the contractor's profit margin.

(1) Communication personnelle, M. Richard d'anjou, for Eng. M.E.R. Lasarre.

The context is quite different for the Waskaganish, Eastmain and Wemindji communities. In the previous example all prior site preparation activities were carried out by the M.E.R., as well as supply and transport of seedlings. Sites are accessible by vehicle and plantation conditions are excellent. Furthermore, plantation surveillance and coordination work is assured by the M.E.R.'s officers. One may easily expect conditions to be totally different for the three communities.

5.1 Purchase of seedlings

Purchase cost of seedlings in containers may vary from fifteen to thirty-four cents (2) as per size of seedlings, species and production period. The M.E.R. could however supply these plants to the community if an official request was transmitted.

5.2 Seedlings transport

Seedlings must be transported by refrigerated trucks. If plants are bought directly from a producer, cost of transport must be paid by buyer. If plants are supplied by the M.E.R. transport is generally assumed by the latter. However, considering distances, transportation costs could be assumed by the communities. Cost of transport has been established at six (6) cents per plant, based on the SEBJ transportation cost of their seedling up to LG-2. The additional expenses required for the plantation are presented below.

5.3 Base camp

In view of impossibility to deliver plants to each community, a base camp will be established in order to permit unloading of plants, storage, preparation before planting, an transport to each community. This base camp will require an irrigation system to conserve plants in good condition and necessary personnel to assure smooth running of operations. Costs of these operations are described in the following article.

5.4 Other costs (expenditures)

Aside from plantation costs, many other parameters are very hard to quantify; specifically, transport of plants from base camp to plantation sites. It is certain that transportation of these plants will be assured by air up to each community and from there to plantation sites by air or land.

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(2) Communication personnelle, M. Fernand Miron, Gen. Manager, Les Serres de Guyenne, Abitibi.

Because of the similarity in the components of the SEBJ's execution plan, the same costs will be applied, eventhough method of seedling in remote areas is not quite similar in every respect. These are established at 40 cents (0.40$) per seedling.

This includes the costs of the base camp, the transportation from LG-2 to the plantation sites and the plantation operations. This cost represents an average cost which could vary for each community. Decreasing transportation facilities in these regions due to the end of the SEBJ construction operations may possibly increase the transportation costs and thus the total reafforestation costs.

Finally, when all costs are regrouped it may be established that it would cost 0.46$ or 0.80$ per seedling depending upon whether seedlings are supplied by the M.E.R. or bought from a private producer.

Cost of these seedlings for each community, is presented in the following table:

Table 5.4.1 Annual cost of plantations

	Amount of plants	Plants origin		Cost/ m^3	
		M.E.R.	Private	M.E.R.	Private
Waskaganish	57 190	0.46	0.80	7.17$	12.46$
Eastmain	17 930	0.46	0.80	6.99$	12.16$
Wemindji	35 160	0.46	0.80	6.42$	11.16$

Costs are similar for the three communities since installation and transport are presumed to be paid, in prorata to number of plants.

All costs related to land preparation, fertilizer or weed-killer are excluded.

6. SYNTHESIS

Creation of artificial stands at these latitudes is not an easy task. In fact, basic data is unavailable, success of such a project is not assured, relative costs for such a projects are important, and various problems related to logistics are yet unsolved.

In the event where reafforestation became a priority, it is recommended to carry out a detailed study on reafforestation possibilities for the commercial harvesting of territories located near the Waskaganish, Eastmain and Wemindji communities.

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(1) Compiled as an expense

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FIREWOOD SUPPLY STUDY
STOCK TABLE (M**3/HA.)

STRATUM: F 83 120 UNIT: WEMINDJI/EASTMAIN/RUPERT-HOUSE

DBH	SAH	EPH	EPN	EPR	PIG	MEL	PET	PEB	ALL/CONI.	ALL/DECI.	TOTAL
10	0.8	0.0	3.5	0.0	0.0	0.1	0.0	0.0	4.4	0.0	4.4
12	2.2	0.0	8.9	0.0	0.0	0.0	0.0	0.0	11.1	0.0	11.1
14	2.2	0.0	13.7	0.0	0.0	0.1	0.0	0.0	16.0	0.0	16.0
16	2.0	0.0	17.9	0.0	0.0	0.0	0.0	0.0	19.8	0.0	19.8
18	1.5	0.0	14.2	0.0	0.0	0.0	0.0	0.0	15.7	0.0	15.7
TOTAL	8.8 *	0.0 *	58.2 *	0.0 *	0.0 *	0.1 *	0.0 *	0.0 *	67.1 *	0.0 *	67.1 *
20	1.2	0.0	14.6	0.0	0.0	0.0	0.0	0.0	15.7	0.0	15.7
22	0.0	0.0	11.0	0.0	0.0	0.0	0.0	0.0	11.0	0.0	11.0
24	2.3	0.0	5.2	0.0	0.0	0.0	0.0	0.0	7.5	0.0	7.5
26	0.0	0.0	1.8	0.0	0.0	0.0	0.0	0.0	1.8	0.0	1.8
28	0.0	0.0	1.5	0.0	0.0	0.0	0.0	0.0	1.5	0.0	1.5
TOTAL	3.5 *	0.0 *	34.1 *	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *	37.6 *	0.0 *	37.6 *
30	0.0	0.0	1.1	0.0	0.0	0.0	0.0	0.0	1.1	0.0	1.1
32	0.0	0.0	0.6	0.0	0.0	0.0	0.0	0.0	0.6	0.0	0.6
34	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
36	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
38	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	1.0
TOTAL	0.0 *	1.0 *	1.8 *	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *	2.8 *	0.0 *	2.8 *
40	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
42	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
44	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
46	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
48	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *
50	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *
TOTAL	12.3 *	1.0 *	94.0 *	0.0 *	0.0 *	0.1 *	0.0 *	0.0 *	107.5 *	0.0 *	107.5 *

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FIREWOOD SUPPLY STUDY
STOCK TABLE (M**3/HA.)

STRATUM: F 84 120 UNIT: WEMINDJI/EASTMAIN/RUPERT-HOUSE

DBH	SAB	EPB	EPN	EPR	PIG	REL	PET	PEB	ALL/CONI.	ALL/DECI.	TOTAL
10	0.5	0.0	5.5	0.0	0.0	0.0	0.0	0.0	6.0	0.0	6.0
12	0.4	0.0	11.7	0.0	0.0	0.0	0.0	0.0	12.1	0.0	12.1
14	0.4	0.0	15.3	0.0	0.0	0.0	0.0	0.0	15.8	0.0	15.8
16	1.3	0.0	12.1	0.0	0.0	0.0	0.0	0.0	13.5	0.0	13.5
18	0.0	0.0	6.6	0.0	0.0	0.0	0.0	0.0	6.6	0.0	6.6
TOTAL	2.6 *	0.0 *	51.2 *	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *	53.8 *	0.0 *	53.8 *
20	1.3	0.0	6.3	0.0	0.0	0.0	0.0	0.0	7.6	0.0	7.6
22	0.0	0.0	9.2	0.0	0.0	0.0	0.0	0.0	9.2	0.0	9.2
24	0.0	0.0	1.6	0.0	0.0	0.0	0.0	0.0	1.6	0.0	1.6
26	0.0	0.0	1.9	0.0	0.0	0.0	0.0	0.0	1.9	0.0	1.9
28	0.0	0.0	2.2	0.0	0.0	0.0	0.0	0.0	2.2	0.0	2.2
TOTAL	1.3 *	0.0 *	21.2 *	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *	22.4 *	0.0 *	22.4 *
30	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
32	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
34	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
36	0.0	0.0	3.3	0.0	0.0	0.0	0.0	0.0	3.3	0.0	3.3
38	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	0.0 *	0.0 *	3.3 *	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *	3.3 *	0.0 *	3.3 *
40	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
42	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
44	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
46	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
48	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *
50	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *
TOTAL	3.9 *	0.0 *	75.7 *	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *	79.6 *	0.0 *	79.6 *

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FIREWOOD SUPPLY STUDY
STOCK TABLE (M**3/HA.)

STRATUM: E C3 120 UNIT: WEMINOJI/EASTMAIN/RUPERT-HOUSE

DBH	SAB	EPB	EPN	EPR	PIG	REL	PET	PEB	ALL/CONT.	ALL/DECI.	TOTAL
10	0.4	0.1	2.3	0.0	0.0	0.0	0.0	0.0	2.9	0.0	2.9
12	1.3	0.5	5.5	0.0	0.0	0.0	0.0	0.0	7.3	0.0	7.3
14	1.3	0.9	9.0	0.0	0.0	0.0	0.0	0.1	11.2	0.1	11.3
16	0.9	0.9	7.9	0.0	0.0	0.0	0.0	0.0	9.7	0.0	9.7
18	0.8	1.2	7.1	0.0	0.0	0.0	0.0	0.0	9.1	0.0	9.1
TOTAL	4.7 *	3.6 *	31.7 *	0.0 *	0.0 *	0.0 *	0.0 *	0.1 *	40.1 *	0.1 *	40.1 *
20	1.5	0.8	8.3	0.0	0.0	0.2	0.0	0.0	10.7	0.0	10.7
22	1.6	1.7	4.6	0.0	0.0	0.0	0.0	0.0	7.9	0.0	7.9
24	0.0	2.6	4.4	0.0	0.0	0.0	0.0	0.0	7.0	0.0	7.0
26	0.3	1.0	1.4	0.0	0.0	0.0	0.0	0.0	2.7	0.0	2.7
28	0.8	1.2	1.3	0.0	0.0	0.0	0.0	0.0	3.2	0.0	3.2
TOTAL	4.3 *	7.2 *	20.0 *	0.0 *	0.0 *	0.2 *	0.0 *	0.0 *	31.6 *	0.0 *	31.6 *
30	0.0	0.9	0.4	0.0	0.0	0.0	0.0	0.0	1.2	0.0	1.2
32	0.0	0.0	0.4	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.4
34	0.0	0.0	0.4	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.4
36	0.0	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.6	0.0	0.6
38	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	0.0 *	1.5 *	1.2 *	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *	2.6 *	0.0 *	2.6 *
40	0.0	0.0	0.6	0.0	0.0	0.0	0.0	0.0	0.6	0.0	0.6
42	0.0	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.7	0.0	0.7
44	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
46	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
48	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	0.0 *	0.7 *	0.6 *	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *	1.3 *	0.0 *	1.3 *
50	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *
TOTAL	9.0 *	13.0 *	53.4 *	0.0 *	0.0 *	0.2 *	0.0 *	0.1 *	75.6 *	0.1 *	75.7 *

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FIREWOOD SUPPLY STUDY
STOCK TABLE (M**3/HA.)

STRATUM: E C4 120 UNIT: WERRIBDJI/EASTMAIN/RUPERT-HOUSE

DBH	SAB	EPB	EPR	EPR	PIG	MEL	PET	PEB	ALL/CONI.	ALL/DECI.	TOTAL
10	0.0	0.0	3.8	0.0	0.0	0.3	0.0	0.0	4.1	0.0	4.1
12	0.0	0.0	8.8	0.0	0.0	0.2	0.0	0.0	9.1	0.0	9.1
14	0.0	0.0	10.2	0.0	0.0	0.0	0.0	0.0	10.2	0.0	10.2
16	0.0	0.3	7.7	0.0	0.0	0.5	0.0	0.0	8.5	0.0	8.5
18	0.0	0.0	7.7	0.0	0.0	0.0	0.0	0.0	7.7	0.0	7.7
TOTAL	0.0 *	0.3 *	38.2 *	0.0 *	0.0 *	1.0 *	0.0 *	0.0 *	39.6 *	0.0 *	39.6 *
20	0.0	0.0	3.9	0.0	0.0	0.0	0.0	0.0	3.9	0.0	3.9
22	0.0	0.0	0.6	0.0	0.0	0.0	0.0	0.0	0.6	0.0	0.6
24	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
26	0.0	0.0	0.9	0.0	0.0	0.0	0.0	0.0	0.9	0.0	0.9
28	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	0.0 *	0.0 *	5.4 *	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *	5.4 *	0.0 *	5.4 *
30	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
32	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
34	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
36	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
38	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *
40	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
42	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
44	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
46	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
48	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *
50	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *
TOTAL	0.0 *	0.3 *	43.7 *	0.0 *	0.0 *	1.0 *	0.0 *	0.0 *	45.0 *	0.0 *	45.0 *

FIREWOOD SUPPLY STUDY
STOCK TABLE (M**3/HA.)

STRATUM: E 03 120 UNIT: WEMINDJI/EASTMAIN/RUPERT-HOUSE

DBH	SAB	EPB	EPN	EPR	PIG	MEL	PET	PEB	ALL/CONT.	ALL/DECI.	TOTAL
10	0.3	0.4	1.6	0.0	0.0	0.1	0.0	0.0	2.4	0.0	2.4
12	0.4	0.6	4.0	0.0	0.1	0.3	0.0	0.0	5.4	0.0	5.4
14	0.8	1.3	5.0	0.0	0.3	0.0	0.0	0.0	7.5	0.0	7.5
16	0.4	2.0	4.1	0.0	0.3	0.2	0.0	0.0	7.0	0.0	7.0
18	0.0	1.1	5.2	0.0	0.4	0.0	0.0	0.0	6.6	0.0	6.6
TOTAL	1.9 *	5.3 *	19.9 *	0.0 *	1.1 *	0.6 *	0.0 *	0.0 *	28.9 *	0.0 *	28.9 *
20	1.3	2.2	5.4	0.0	0.2	0.0	0.0	0.0	9.2	0.0	9.2
22	0.7	2.1	2.8	0.0	0.0	0.0	0.0	0.0	5.6	0.0	5.6
24	1.3	0.0	2.7	0.0	0.0	0.0	0.0	0.0	4.0	0.0	4.0
26	0.5	2.5	2.4	0.0	0.0	0.0	0.0	0.0	5.4	0.0	5.4
28	0.6	1.7	0.9	0.0	0.0	0.0	0.0	0.0	3.2	0.0	3.2
TOTAL	4.4 *	8.4 *	14.2 *	0.0 *	0.2 *	0.0 *	0.0 *	0.0 *	27.2 *	0.0 *	27.2 *
30	0.7	1.3	0.0	0.0	0.0	0.0	0.0	0.0	1.9	0.0	1.9
32	0.0	2.1	1.7	0.0	0.0	0.0	0.0	0.0	3.8	0.0	3.8
34	0.0	3.1	0.0	0.0	0.0	0.0	0.0	0.0	3.1	0.0	3.1
36	0.0	1.7	0.0	0.0	0.0	0.0	0.0	0.0	1.7	0.0	1.7
38	0.0	1.9	0.0	0.0	0.0	0.0	0.0	0.0	1.9	0.0	1.9
TOTAL	0.7 *	10.0 *	1.7 *	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *	12.4 *	0.0 *	12.4 *
40	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
42	0.0	2.2	0.9	0.0	0.0	0.0	0.0	0.0	3.0	0.0	3.0
44	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
46	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
48	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	0.0 *	2.2 *	0.9 *	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *	3.0 *	0.0 *	3.0 *
50	0.0 *	1.4 *	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *	1.4 *	0.0 *	1.4 *
TOTAL	7.0 *	27.4 *	36.7 *	0.0 *	1.4 *	0.6 *	0.0 *	0.0 *	73.0 *	0.0 *	73.0 *

FIREWOOD SUPPLY STUDY
STOCK TABLE (M**3/HA.)

STRATUM: E D4 120 UNIT: WEMINDJI/EASTMAIN/RUPERT-HOUSE

DBH	SAB	EPB	EPN	EPR	PIG	REL	PET	PEB	ALL/CONI.	ALL/DECI.	TOTAL
10	0.2	0.1	2.7	0.0	0.0	0.0	0.0	0.0	3.0	0.0	3.0
12	0.3	0.0	7.1	0.0	0.0	0.0	0.0	0.0	7.4	0.0	7.4
14	0.3	0.3	7.8	0.0	0.0	0.0	0.0	0.0	8.5	0.0	8.5
16	0.0	1.5	2.1	0.0	0.0	0.0	0.0	0.0	3.6	0.0	3.6
18	0.7	2.8	2.9	0.0	0.0	0.0	0.0	0.0	6.3	0.0	6.3
TOTAL	1.4 *	4.7 *	22.7 *	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *	28.8 *	0.0 *	28.8 *
20	0.0	0.9	4.4	0.0	0.0	0.0	0.0	0.0	5.3	0.0	5.3
22	0.0	3.4	3.7	0.0	0.0	0.0	0.0	0.0	7.1	0.0	7.1
24	1.4	0.0	1.1	0.0	0.0	0.0	0.0	0.0	2.5	0.0	2.5
26	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
28	0.0	1.9	0.0	0.0	0.0	0.0	0.0	0.0	1.9	0.0	1.9
TOTAL	1.4 *	6.2 *	9.2 *	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *	16.8 *	0.0 *	16.8 *
30	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
32	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
34	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
36	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
38	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *
40	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
42	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
44	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
46	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
48	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *
50	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *
TOTAL	2.8 *	10.9 *	31.9 *	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *	45.6 *	0.0 *	45.6 *

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FIREWOOD SUPPLY STUDY
STOCK TABLE (M**3/HA.)

STRATUM: TK C3 90 UNIT: WEMINDJI/EASTMAIN/RUPERT-HOUSE

DBH	SAB	EPB	EPN	EPR	PIG	MEL	PET	PEB	ALL/CONI.	ALL/DECI.	TOTAL
10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
12	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
14	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
16	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.1	0.0	2.1	2.1
18	0.0	0.0	0.0	0.0	0.0	0.0	1.5	3.0	0.0	4.6	4.6
TOTAL	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *	1.5 *	5.1 *	0.0 *	6.6 *	6.6 *
20	0.0	0.0	0.0	0.0	0.0	0.0	6.3	0.0	0.0	6.3	6.3
22	0.0	0.0	0.0	0.0	0.0	0.0	5.5	5.5	0.0	11.1	11.1
24	0.0	0.0	0.0	0.0	0.0	0.0	3.5	14.2	0.0	17.7	17.7
26	0.0	0.0	0.0	0.0	0.0	0.0	17.7	13.3	0.0	30.9	30.9
28	0.0	0.0	0.0	0.0	0.0	0.0	10.8	0.0	0.0	10.8	10.8
TOTAL	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *	43.8 *	33.0 *	0.0 *	76.8 *	76.8 *
30	0.0	0.0	0.0	0.0	0.0	0.0	19.4	12.9	0.0	32.3	32.3
32	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.6	0.0	7.6	7.6
34	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
36	0.0	0.0	0.0	0.0	0.0	0.0	0.0	20.5	0.0	20.5	20.5
38	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11.7	0.0	11.7	11.7
TOTAL	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *	19.4 *	52.8 *	0.0 *	72.2 *	72.2 *
40	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
42	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
44	0.0	0.0	0.0	0.0	0.0	0.0	16.4	0.0	0.0	16.4	16.4
46	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
48	0.0	0.0	0.0	0.0	0.0	0.0	0.0	19.8	0.0	19.8	19.8
TOTAL	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *	16.4 *	19.8 *	0.0 *	36.3 *	36.3 *
50	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *
TOTAL	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *	81.2 *	110.7 *	0.0 *	191.9 *	191.9 *

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TABLE DE STOCK

VOLUME MARCHAND/BRUT EN PI.CU.

REFERENCE NO. 0273CC01 ZONE EASTMAIN

STRATE ------- R PG C 4 J AUCUNE
CARTOGRAPHIQUE TYPE GRP.ESS. H/O STADE PERTURBATION AGE

DHP Age EN PO.	EPN	PIG	BOP	RES.	FEUIL.	TOUTES
4	11.7	82.5	2.0	94.2	2.0	96.2
5	19.9	165.7	2.5	185.6	2.5	188.1
6	8.7	147.3		156.0		156.0
7	6.6	41.0		47.6		47.6
8	18.1	39.2		57.3		57.3
9		13.2		13.2		13.2
TOTAL TOUTES	65.0	488.9	4.5	553.9	4.5	558.4

ECART TYPE ..... 133.05 ERREUR DE LA MOYENNE ... 54.32

NOMBRE DE PARCELLES 6 PRECISION DU VOLUME/ACRE 75.0%

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TABLE DE STCCP

VOLUME MARCHAND/BRUT EN PI.CU.

REFERENCE NO. 0273CC01 ZONE EASTMAIN

STRATE ------- A PG 0 4 J AUCUNE
CARTOGRAPHIQUE TYPE GRP.ESS. H/D STADE PERTURBATION AGE

CLP A.E. EN PO.	EPN	PIG	PET	RES.	FEUIL.	TOUTES
4	33.6	99.4	1.9	133.0	1.9	134.5
5	36.4	164.9	1.7	201.3	1.7	203.0
6	14.6	85.6		104.2		104.2
7		49.6		49.6		49.6
8	6.0			6.0		6.0
TOTAL TOUTES	90.6	399.5	3.2	490.1	3.2	493.3

ECART TYPE ..... 266.52 ERREUR DE LA MOYENNE ... 88.84

NOMBRE DE PARCELLES 9 PRECISION DU VOLUME/ACRE 98.4%

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TABLE DE STOCK

VOLUME MARCHAND/BRUT EN PI.CU.

REFERENCE NO. 02730C01 ZONE EASTMAIN

STRATE CARTOGRAPHIQUE ------- P TYPE BBR GRP.ESS. C 4 H/D J STADE AUCUNE PERTURBATION AGE

CMP A.E. EN PO.	EPN	BOP	PE1	RES.	FEUIL.	TOUTES
4			4.5		4.5	4.5
5	59.6	14.8		59.6	14.8	74.4
6	52.4	28.9		52.4	28.9	81.3
7	157.6	93.2		157.6	93.2	250.8
8	54.3	67.9		54.3	67.9	122.2
9		92.9			92.9	92.9
10		121.7			121.7	121.7
TOTAL TOUTES	323.9	419.4	4.5	323.9	423.9	747.8

ECART TYPE ..... 448.20 ERREUR DE LA MOYENNE ... 448.20

NOMBRE DE PARCELLES 1 PRECISION DU VOLUME/ACRE 100.0%

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FIREWOOD SUPPLY STUDY
STAND TABLE (#STEMS/HA.)

STRATUM: F 83 120 UNIT: WEMINDJI/EASTMAIN/RUPERT-HOUSE

DBH	SAB	EPB	EPR	EPR	PIG	REL	PET	PEB	ALL/CONI.	ALL/DECI.	TOTAL
2	383.3	0.0	383.3	0.0	0.0	0.0	0.0	0.0	766.7	0.0	766.7
4	333.3	0.0	416.7	0.0	0.0	0.0	0.0	0.0	750.0	0.0	750.0
6	200.0	0.0	400.0	0.0	0.0	0.0	0.0	0.0	600.0	0.0	600.0
8	200.0	0.0	333.3	0.0	0.0	0.0	0.0	0.0	533.3	0.0	533.3
TOTAL	1,116.6 *	0.0 *	1,533.3 *	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *	2,650.0 *	0.0 *	2,650.0 *
10	78.7	0.0	251.7	0.0	0.0	3.3	0.0	0.0	331.7	0.0	331.7
12	71.7	0.0	261.7	0.0	0.0	0.0	0.0	0.0	333.3	0.0	333.3
14	36.7	0.0	236.7	0.0	0.0	1.7	0.0	0.0	275.0	0.0	275.0
16	21.7	0.0	210.0	0.0	0.0	0.0	0.0	0.0	231.7	0.0	231.7
18	11.7	0.0	123.3	0.0	0.0	0.0	0.0	0.0	135.0	0.0	135.0
TOTAL	218.5 *	0.0 *	1,083.4 *	0.0 *	0.0 *	5.0 *	0.0 *	0.0 *	1,306.7 *	0.0 *	1,306.7 *
20	6.7	0.0	98.3	0.0	0.0	0.0	0.0	0.0	105.0	0.0	105.0
22	0.0	0.0	60.0	0.0	0.0	0.0	0.0	0.0	60.0	0.0	60.0
24	8.3	0.0	23.3	0.0	0.0	0.0	0.0	0.0	31.7	0.0	31.7
26	0.0	0.0	6.7	0.0	0.0	0.0	0.0	0.0	6.7	0.0	6.7
28	0.0	0.0	5.0	0.0	0.0	0.0	0.0	0.0	5.0	0.0	5.0
TOTAL	15.0 *	0.0 *	193.3 *	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *	208.4 *	0.0 *	208.4 *
30	0.0	0.0	3.3	0.0	0.0	0.0	0.0	0.0	3.3	0.0	3.3
32	0.0	0.0	1.7	0.0	0.0	0.0	0.0	0.0	1.7	0.0	1.7
34	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
36	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
38	0.0	1.7	0.0	0.0	0.0	0.0	0.0	0.0	1.7	0.0	1.7
TOTAL	0.0 *	1.7 *	5.0 *	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *	6.7 *	0.0 *	6.7 *
40	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
42	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
44	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
46	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
48	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *
50	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *
TOTAL	1,350.1 *	1.7 *	2,815.0 *	0.0 *	0.0 *	5.0 *	0.0 *	0.0 *	4,171.8 *	0.0 *	4,171.8 *

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FIREWOOD SUPPLY STUDY
STAND TABLE (STEMS/HA.)

STRATUM: E 84 120 UNIT: WEMINDJI/EASTMAIN/RUPERT-HOUSE

DBH	SAB	EPB	EPH	EPR	PIG	REL	PET	PEB	ALL/CONI.	ALL/DECI.	TOTAL
2	0.0	0.0	785.7	0.0	0.0	0.0	0.0	0.0	785.7	0.0	785.7
4	0.0	0.0	571.4	0.0	0.0	0.0	0.0	0.0	571.4	0.0	571.4
6	71.4	0.0	714.3	0.0	0.0	0.0	0.0	0.0	785.7	0.0	785.7
8	0.0	0.0	642.9	0.0	0.0	0.0	0.0	0.0	642.9	0.0	642.9
TOTAL	71.4 *	0.0 *	2,714.3 *	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *	2,785.7 *	0.0 *	2,785.7 *
10	42.9	0.0	392.9	0.0	0.0	0.0	0.0	0.0	435.7	0.0	435.7
12	14.3	0.0	342.9	0.0	0.0	0.0	0.0	0.0	357.1	0.0	357.1
14	7.1	0.0	264.3	0.0	0.0	0.0	0.0	0.0	271.4	0.0	271.4
16	14.3	0.0	142.9	0.0	0.0	0.0	0.0	0.0	157.1	0.0	157.1
18	0.0	0.0	57.1	0.0	0.0	0.0	0.0	0.0	57.1	0.0	57.1
TOTAL	78.6 *	0.0 *	1,200.1 *	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *	1,278.4 *	0.0 *	1,278.4 *
20	7.1	0.0	42.9	0.0	0.0	0.0	0.0	0.0	50.0	0.0	50.0
22	0.0	0.0	50.0	0.0	0.0	0.0	0.0	0.0	50.0	0.0	50.0
24	0.0	0.0	7.1	0.0	0.0	0.0	0.0	0.0	7.1	0.0	7.1
26	0.0	0.0	7.1	0.0	0.0	0.0	0.0	0.0	7.1	0.0	7.1
28	0.0	0.0	7.1	0.0	0.0	0.0	0.0	0.0	7.1	0.0	7.1
TOTAL	7.1 *	0.0 *	114.2 *	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *	121.3 *	0.0 *	121.3 *
30	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
32	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
34	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
36	0.0	0.0	7.1	0.0	0.0	0.0	0.0	0.0	7.1	0.0	7.1
38	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	0.0 *	0.0 *	7.1 *	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *	7.1 *	0.0 *	7.1 *
40	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
42	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
44	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
46	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
48	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *
50	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *
TOTAL	157.1 *	0.0 *	4,035.7 *	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *	4,192.5 *	0.0 *	4,192.5 *

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FIREWOOD SUPPLY STUDY
STAND TABLE (STEMS/HA.)

STRATUM: E C3 120 UNIT: WEMINDJI/EASTMAIN/RUPERT-HOUSE

DBH	SAB	EPB	EPN	EPR	PIG	MEL	PET	PEB	ALL/CONI.	ALL/DECI.	TOTAL
2	270.8	20.8	604.2	0.0	0.0	0.0	0.0	0.0	895.8	0.0	895.8
4	177.1	0.0	260.4	0.0	0.0	0.0	0.0	0.0	437.5	0.0	437.5
6	114.6	10.4	187.5	0.0	0.0	0.0	0.0	0.0	312.5	0.0	312.5
8	125.0	0.0	197.9	0.0	0.0	0.0	0.0	0.0	322.9	0.0	322.9
TOTAL	687.5 *	31.2 *	1,250.0 *	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *	1,968.7 *	0.0 *	1,968.7 *
10	39.6	10.4	161.5	0.0	0.0	1.0	0.0	0.0	212.5	0.0	212.5
12	41.7	13.5	161.5	0.0	0.0	0.0	0.0	0.0	216.7	0.0	216.7
14	21.9	13.5	155.2	0.0	0.0	0.0	0.0	1.0	190.6	1.0	191.7
16	9.4	9.4	92.7	0.0	0.0	0.0	0.0	0.0	111.5	0.0	111.5
18	8.3	8.3	61.5	0.0	0.0	0.0	0.0	0.0	76.0	0.0	76.0
TOTAL	118.9 *	55.1 *	632.4 *	0.0 *	0.0 *	1.0 *	0.0 *	1.0 *	807.3 *	1.0 *	808.4 *
20	8.3	4.2	56.3	0.0	0.0	1.0	0.0	0.0	69.8	0.0	69.8
22	7.3	7.3	25.0	0.0	0.0	0.0	0.0	0.0	39.6	0.0	39.6
24	0.0	9.4	19.8	0.0	0.0	0.0	0.0	0.0	29.2	0.0	29.2
26	1.0	3.1	5.2	0.0	0.0	0.0	0.0	0.0	9.4	0.0	9.4
28	2.1	3.1	4.2	0.0	0.0	0.0	0.0	0.0	9.4	0.0	9.4
TOTAL	18.7 *	27.1 *	110.5 *	0.0 *	0.0 *	1.0 *	0.0 *	0.0 *	157.4 *	0.0 *	157.4 *
30	0.0	2.1	1.0	0.0	0.0	0.0	0.0	0.0	3.1	0.0	3.1
32	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	1.0
34	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	1.0
36	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	1.0
38	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	0.0 *	3.1 *	3.0 *	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *	6.1 *	0.0 *	6.1 *
40	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	1.0
42	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	1.0
44	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
46	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
48	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	0.0 *	1.0 *	1.0 *	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *	2.0 *	0.0 *	2.0 *
50	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *
TOTAL	825.1 *	117.5 *	1,996.9 *	0.0 *	0.0 *	2.0 *	0.0 *	1.0 *	2,941.5 *	1.0 *	2,942.6 *

DATE: 29-MAR-84

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FIREWOOD SUPPLY STUDY
STAND TABLE (#STEMS/HA.)

STRATUM: E C4 120 UNIT: WEMINDJI/EASTMAIN/RUPERT-HOUSE

DBH	SAB	EPB	EPN	EPR	PIG	BEL	PET	PEB	ALL/CONI.	ALL/DECI.	TOTAL
2	0.0	0.0	733.3	0.0	0.0	0.0	0.0	0.0	733.3	0.0	733.3
4	0.0	0.0	866.7	0.0	0.0	0.0	0.0	0.0	866.7	0.0	866.7
6	0.0	0.0	366.7	0.0	0.0	66.7	0.0	0.0	433.3	0.0	433.3
8	0.0	0.0	433.3	0.0	0.0	0.0	0.0	0.0	433.3	0.0	433.3
TOTAL	0.0 *	0.0 *	2,400.0 *	0.0 *	0.0 *	66.7 *	0.0 *	0.0 *	2,466.6 *	0.0 *	2,466.6 *
10	0.0	0.0	273.3	0.0	0.0	16.7	0.0	0.0	290.0	0.0	290.0
12	0.0	0.0	260.0	0.0	0.0	6.7	0.0	0.0	266.7	0.0	266.7
14	0.0	0.0	176.7	0.0	0.0	0.0	0.0	0.0	176.7	0.0	176.7
16	0.0	3.3	90.0	0.0	0.0	6.7	0.0	0.0	100.0	0.0	100.0
18	0.0	0.0	66.7	0.0	0.0	0.0	0.0	0.0	66.7	0.0	66.7
TOTAL	0.0 *	3.3 *	866.7 *	0.0 *	0.0 *	30.1 *	0.0 *	0.0 *	900.1 *	0.0 *	900.1 *
20	0.0	0.0	26.7	0.0	0.0	0.0	0.0	0.0	26.7	0.0	26.7
22	0.0	0.0	3.3	0.0	0.0	0.0	0.0	0.0	3.3	0.0	3.3
24	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
26	0.0	0.0	3.3	0.0	0.0	0.0	0.0	0.0	3.3	0.0	3.3
28	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	0.0 *	0.0 *	33.3 *	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *	33.3 *	0.0 *	33.3 *
30	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
32	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
34	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
36	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
38	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *
40	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
42	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
44	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
46	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
48	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *
50	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *
TOTAL	0.0 *	3.3 *	3,300.0 *	0.0 *	0.0 *	96.8 *	0.0 *	0.0 *	3,400.0 *	0.0 *	3,400.0 *

FIREWOOD SUPPLY STUDY
STAND TABLE (#STEMS/HA.)

STRATUM: E D3 E20 UNIT: WEMINDJI/EASTMAIN/RUPERT-HOUSE

DBH	SAB	EPB	EPN	EPR	PIG	REL	PET	PEB	ALL/CONI.	ALL/DECI.	TOTAL
2	181.8	45.5	545.5	0.0	0.0	0.0	0.0	0.0	772.7	0.0	772.7
4	272.7	30.3	227.3	0.0	0.0	0.0	0.0	0.0	530.3	0.0	530.3
6	75.8	121.2	197.0	0.0	0.0	0.0	0.0	0.0	393.9	0.0	393.9
8	75.8	45.5	106.7	0.0	0.0	0.0	0.0	0.0	287.9	0.0	287.9
TOTAL	606.1 *	242.5 *	1,136.5 *	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *	1,984.8 *	0.0 *	1,984.8 *
10	27.3	25.8	115.2	0.0	3.0	4.5	0.0	0.0	175.8	0.0	175.8
12	13.6	16.7	116.7	0.0	4.5	7.6	0.0	0.0	159.1	0.0	159.1
14	13.6	19.7	86.4	0.0	6.1	0.0	0.0	0.0	125.8	0.0	125.8
16	4.5	19.7	48.5	0.0	3.0	3.0	0.0	0.0	78.8	0.0	78.8
18	0.0	7.6	45.5	0.0	3.0	0.0	0.0	0.0	56.1	0.0	56.1
TOTAL	59.0 *	89.5 *	412.3 *	0.0 *	19.6 *	15.1 *	0.0 *	0.0 *	595.6 *	0.0 *	595.6 *
20	7.6	12.1	36.4	0.0	1.5	0.0	0.0	0.0	57.6	0.0	57.6
22	3.0	9.1	15.2	0.0	0.0	0.0	0.0	0.0	27.3	0.0	27.3
24	4.5	0.0	12.1	0.0	0.0	0.0	0.0	0.0	16.7	0.0	16.7
26	1.5	7.6	9.1	0.0	0.0	0.0	0.0	0.0	18.2	0.0	18.2
28	1.5	4.5	3.0	0.0	0.0	0.0	0.0	0.0	9.1	0.0	9.1
TOTAL	18.1 *	33.3 *	75.8 *	0.0 *	1.5 *	0.0 *	0.0 *	0.0 *	128.9 *	0.0 *	128.9 *
30	1.5	3.0	0.0	0.0	0.0	0.0	0.0	0.0	4.5	0.0	4.5
32	0.0	4.5	4.5	0.0	0.0	0.0	0.0	0.0	9.1	0.0	9.1
34	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	6.1	0.0	6.1
36	0.0	3.0	0.0	0.0	0.0	0.0	0.0	0.0	3.0	0.0	3.0
38	0.0	3.0	0.0	0.0	0.0	0.0	0.0	0.0	3.0	0.0	3.0
TOTAL	1.5 *	14.6 *	4.5 *	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *	25.7 *	0.0 *	25.7 *
40	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
42	0.0	3.0	1.5	0.0	0.0	0.0	0.0	0.0	4.5	0.0	4.5
44	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
46	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
48	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	0.0 *	3.0 *	1.5 *	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *	4.5 *	0.0 *	4.5 *
50	0.0 *	3.0 *	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *	3.0 *	0.0 *	3.0 *
TOTAL	684.7 *	390.9 *	1,630.6 *	0.0 *	21.1 *	15.1 *	0.0 *	0.0 *	2,742.5 *	0.0 *	2,742.5 *

FIREWOOD SUPPLY STUDY
STAND TABLE (STEMS/HA.)

STRATUM: E 04 120 UNIT: WEMINDJI/EASTMAIN/RUPERT-HOUSE

DBH	SAB	EPB	EPN	EPR	PIG	MEL	PET	PEB	ALL/CONI.	ALL/DECI.	TOTAL
2	0.0	0.0	350.0	0.0	0.0	0.0	0.0	0.0	350.0	0.0	350.0
4	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0	100.0	0.0	100.0
6	0.0	0.0	300.0	0.0	0.0	0.0	0.0	0.0	300.0	0.0	300.0
8	0.0	100.0	150.0	0.0	0.0	50.0	0.0	0.0	300.0	0.0	300.0
TOTAL	0.0 *	100.0 *	900.0 *	0.0 *	0.0 *	50.0 *	0.0 *	0.0 *	1,050.0 *	0.0 *	1,050.0 *
10	15.0	5.0	195.0	0.0	0.0	0.0	0.0	0.0	215.0	0.0	215.0
12	10.0	0.0	210.0	0.0	0.0	0.0	0.0	0.0	220.0	0.0	220.0
14	5.0	5.0	135.0	0.0	0.0	0.0	0.0	0.0	145.0	0.0	145.0
16	0.0	15.0	25.0	0.0	0.0	0.0	0.0	0.0	40.0	0.0	40.0
18	5.0	20.0	25.0	0.0	0.0	0.0	0.0	0.0	50.0	0.0	50.0
TOTAL	35.0 *	45.0 *	590.0 *	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *	670.0 *	0.0 *	670.0 *
20	0.0	5.0	30.0	0.0	0.0	0.0	0.0	0.0	35.0	0.0	35.0
22	0.0	15.0	20.0	0.0	0.0	0.0	0.0	0.0	35.0	0.0	35.0
24	5.0	0.0	5.0	0.0	0.0	0.0	0.0	0.0	10.0	0.0	10.0
26	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
28	0.0	5.0	0.0	0.0	0.0	0.0	0.0	0.0	5.0	0.0	5.0
TOTAL	5.0 *	25.0 *	55.0 *	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *	85.0 *	0.0 *	85.0 *
30	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
32	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
34	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
36	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
38	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *
40	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
42	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
44	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
46	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
48	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *
50	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *
TOTAL	40.0 *	170.0 *	1,545.0 *	0.0 *	0.0 *	50.0 *	0.0 *	0.0 *	1,805.0 *	0.0 *	1,805.0 *

FIREWOOD SUPPLY STUDY
STAND TABLE (#STEMS/HA.)

STRATUM: TR C3 90 UNIT: WEMINDJI/EASTMAIN/RUPERT-HOUSE

DBH	SAB	EPB	EPN	EPR	PIG	REL	PET	PEB	ALL/CONI.	ALL/DECI.	TOTAL
2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0	0.0	100.0	100.0
TOTAL	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *	100.0 *	0.0 *	100.0 *	100.0 *
10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
12	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
14	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
16	0.0	0.0	0.0	0.0	0.0	0.0	0.0	20.0	0.0	20.0	20.0
18	0.0	0.0	0.0	0.0	0.0	0.0	10.0	20.0	0.0	30.0	30.0
TOTAL	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *	10.0 *	40.0 *	0.0 *	50.0 *	50.0 *
20	0.0	0.0	0.0	0.0	0.0	0.0	30.0	0.0	0.0	30.0	30.0
22	0.0	0.0	0.0	0.0	0.0	0.0	20.0	20.0	0.0	40.0	40.0
24	0.0	0.0	0.0	0.0	0.0	0.0	10.0	40.0	0.0	50.0	50.0
26	0.0	0.0	0.0	0.0	0.0	0.0	40.0	30.0	0.0	70.0	70.0
28	0.0	0.0	0.0	0.0	0.0	0.0	20.0	0.0	0.0	20.0	20.0
TOTAL	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *	120.0 *	90.0 *	0.0 *	210.0 *	210.0 *
30	0.0	0.0	0.0	0.0	0.0	0.0	30.0	20.0	0.0	50.0	50.0
32	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.0	0.0	10.0	10.0
34	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
36	0.0	0.0	0.0	0.0	0.0	0.0	0.0	20.0	0.0	20.0	20.0
38	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.0	0.0	10.0	10.0
TOTAL	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *	30.0 *	60.0 *	0.0 *	90.0 *	90.0 *
40	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
42	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
44	0.0	0.0	0.0	0.0	0.0	0.0	10.0	0.0	0.0	10.0	10.0
46	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
48	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.0	0.0	10.0	10.0
TOTAL	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *	10.0 *	10.0 *	0.0 *	20.0 *	20.0 *
50	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *
TOTAL	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *	0.0 *	170.0 *	300.0 *	0.0 *	470.0 *	470.0 *

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TABLE DE PEUPLEMENT

NOMBRE DE TIGE A L'ACRE

REFERENCE NO. 02730001 ZONE EASTMAIN

STRATE CARTOGRAPHIQUE ------- R TYPE PG GRP.ESS. C 4 H/D J STADE AUCUNE PERTURBATION AGE

DHP A.E. EN PO.	EPN	PIG	BOP	RES.	FEUIL.	TOUTES
1	66.7			66.7		66.7
2	50.0	16.7		66.7		66.7
3	50.0	200.0		250.0		250.0
TOTAL 1+2+3	166.7	216.7		383.4		383.4
4	21.7	169.0	9.0	186.7	9.0	191.7
5	13.3	118.3	1.7	131.6	1.7	133.3
6	3.3	56.7		60.0		60.0
7	1.7	10.0		11.7		11.7
8	3.3	6.7		10.0		10.0
9		1.7		1.7		1.7
TOTAL 4+	43.3	358.4	6.7	401.7	6.7	408.4
TOTAL TOUTES	210.0	575.1	6.7	785.1	6.7	791.8

CATE 13/01/73 M.T.F. SERVICE DE L'INVENTAIRE FORESTIER

TABLE DE PEUPLEMENT

NOMBRE DE TIGE A L'ACRE

REFERENCE NO. 0273OCC1 ZONE EASTMAIN

STRATE CARTOGRAPHIQUE ------- R TYPE PG GRP.ESS. D 4 H/O J STADE AUCUNE PERTURBATION

DHP A.E. EN PO.	EPN	PIG	BOP	PET	AGE RES.	AGE FEUIL.	AGE TOUTES
1	755.6	44.4			800.0		800.0
2	211.1	166.7	55.6		377.8	55.6	433.4
3	33.3	188.9			222.2		222.2
TOTAL 1+2+3	1000.0	400.0	55.6		1400.0	55.6	1455.6
4	62.2	198.9		3.3	261.1	3.3	264.4
5	24.4	117.8		1.1	142.2	1.1	143.3
6	5.6	34.4			40.0		40.0
7		11.1			11.1		11.1
8	1.1				1.1		1.1
TOTAL 4+	93.3	362.2		4.4	455.5	4.4	459.9
TOTAL TOUTES	1093.3	762.2	55.6	4.4	1855.5	60.0	1915.5

DATE 13/01/73 M.L.F. SERVICE DE L'INVENTAIRE FORESTIER

TABLE DE PEUPLEMENT

NOMBRE DE TIGE A L'ACRE

REFERENCE NO. 02730001 ZONE EASTMAIN

STRATE ------- CARTOGRAPHIQUE | M TYPE | BBR GRP.ESS. | C 4 H/D | J STADE | AUCUNE PERTURBATION

CLP A.E. EN PO.	EPN	BOP	PET	AGE RES.	AGE FEUIL.	AGE TOUTES
1						
2						
3						
TOTAL 1+2+3						
4			10.0			
5	40.0	10.0			10.0	10.0
6	20.0	10.0		40.0	10.0	50.0
7	40.0	20.0		20.0	10.0	30.0
8	10.0	10.0		40.0	20.0	60.0
9		10.0		10.0	10.0	20.0
10		10.0			10.0	10.0
TOTAL 4+	110.0	70.0	10.0		10.0	10.0
TOTAL TOUTES	110.0	70.0	10.0	110.0	80.0	190.0
				110.0	80.0	190.0

APPENDIX 9

ECONOMIC ANALYSIS WORKSHEETS

PRESENT VALUE OF AN ALTERNATIVE
IN CONSTANT DOLLARS

	YEARS											
	13	14	15	16	17	18	19	20	21	22	23	24
INVESTMENTS												
LAND	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CONSTRUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ENGINEERING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
EQUIPMENT	0.0	0.0	156.1	0.0	45.8	0.0	302.0	0.0	100.1	91.5	0.0	45.8
VEHICLES	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CONVERSION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
INTEREST DURING CONST.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	0.0	0.0	156.1	0.0	45.8	0.0	302.0	0.0	100.1	91.5	0.0	45.8
OPERATION EXPENSES												
COST OF ENERGY	315.9	315.9	331.4	331.4	346.9	371.7	371.7	371.7	371.7	375.0	378.4	438.1
MAINTENANCE COSTS	45.6	45.6	48.6	48.6	51.6	51.6	54.6	54.6	54.6	57.6	57.6	60.6
TOTAL	361.5	361.5	380.0	380.0	398.5	423.3	426.3	426.3	426.3	432.6	436.0	513.7
TOTAL COST	361.5	361.5	536.1	380.0	444.3	423.3	728.3	426.3	526.4	524.1	436.0	559.5

PRESENT VALUE OF AN ALTERNATIVE
IN CONSTANT DOLLARS

	YEARS											
	25	26	27	28	29	30	31	32	33	34	35	36
INVESTMENTS												
LAND	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CONSTRUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ENGINEERING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
EQUIPMENT	45.8	45.8	91.5	0.0	45.8	45.8	0.0	0.0	0.0	0.0	0.0	0.0
VEHICLES	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CONVERSION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
INTEREST DURING CONST.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	45.8	45.8	91.5	0.0	45.8	45.8	0.0	0.0	0.0	0.0	0.0	0.0
OPERATION EXPENSES												
COST OF ENERGY	457.1	461.1	464.5	468.5	472.4	476.4	0.0	0.0	0.0	0.0	0.0	0.0
MAINTENANCE COSTS	60.6	63.6	66.6	66.6	69.6	69.6	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	517.7	524.7	531.1	535.1	542.0	546.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL COST	563.5	570.5	622.6	535.1	587.8	591.8	0.0	0.0	0.0	0.0	0.0	0.0

10

PRESENT VALUE OF AN ALTERNATIVE
IN CONSTANT DOLLARS

	YEARS											
	1	2	3	4	5	6	7	8	9	10	11	12
INVESTMENTS												
LAND	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CONSTRUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ENGINEERING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	24.0	0.0	24.0
EQUIPMENT	0.0	24.0	0.0	0.0	24.0	0.0	24.0	0.0	0.0	0.0	0.0	0.0
VEHICLES	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FURNITURE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
INTEREST DURING CONST.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	0.0	24.0	0.0	0.0	24.0	0.0	24.0	0.0	0.0	24.0	0.0	24.0
OPERATION EXPENSES												
COST OF ENERGY	304.0	323.2	323.2	320.8	348.1	347.5	365.2	363.5	361.9	379.1	379.1	399.2
MAINTENANCE COSTS	15.3	16.8	16.8	16.8	18.3	18.3	19.8	19.8	19.8	21.3	21.3	22.8
TOTAL	319.3	340.0	340.0	337.6	366.4	365.8	385.0	383.3	381.7	400.4	400.4	422.0
TOTAL COST	319.3	364.0	340.0	337.6	390.4	365.8	409.0	383.3	381.7	424.4	400.4	446.0

PRESENT VALUE = 6217./

PRESENT VALUE OF AN ALTERNATIVE
IN CONSTANT DOLLARS

	YEARS											
	13	14	15	16	17	18	19	20	21	22	23	24
INVESTMENTS												
LAND	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CONSTRUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ENGINEERING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
EQUIPMENT	0.0	0.0	134.4	0.0	24.0	0.0	158.4	0.0	0.0	48.0	0.0	24.0
VEHICLES	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FURNITURE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
INTEREST DURING CONST.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	0.0	0.0	134.4	0.0	24.0	0.0	158.4	0.0	0.0	48.0	0.0	24.0
OPERATION EXPENSES												
COST OF ENERGY	399.2	399.2	418.6	418.6	438.0	469.2	469.2	469.2	469.2	474.2	479.3	574.5
MAINTENANCE COSTS	22.8	22.8	24.3	24.3	25.8	25.8	27.3	27.3	27.3	28.8	28.8	30.3
TOTAL	422.0	422.0	442.9	442.9	463.8	495.0	496.5	496.5	496.5	503.0	508.1	604.8
TOTAL COST	422.0	422.0	577.3	442.9	487.8	495.0	654.9	496.5	496.5	551.0	508.1	628.8

PRESENT VALUE OF AN ALTERNATIVE
IN CONSTANT DOLLARS

	YEARS											
	25	26	27	28	29	30	31	32	33	34	35	36
INVESTMENTS												
LAND	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CONSTRUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ENGINEERING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
EQUIPMENT	24.0	24.0	48.0	0.0	24.0	24.0	0.0	0.0	0.0	0.0	0.0	0.0
VEHICLES	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FURNITURE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
INTEREST DURING CONST.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	24.0	24.0	48.0	0.0	24.0	24.0	0.0	0.0	0.0	0.0	0.0	0.0
OPERATION EXPENSES												
COST OF ENERGY	580.5	586.5	591.7	597.7	603.7	609.7	0.0	0.0	0.0	0.0	0.0	0.0
MAINTENANCE COSTS	30.3	31.8	33.3	33.3	34.8	34.8	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	610.8	618.3	625.0	631.0	638.5	644.5	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL COST	634.8	642.3	673.0	631.0	662.5	668.5	0.0	0.0	0.0	0.0	0.0	0.0

10

PRESENT VALUE OF AN ALTERNATIVE
IN CONSTANT DOLLARS

	YEARS											
	1	2	3	4	5	6	7	8	9	10	11	12
INVESTMENTS												
LAND	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CONSTRUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ENGINEERING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
EQUIPMENT	100.1	45.8	0.0	0.0	45.8	0.0	45.8	0.0	0.0	45.8	0.0	45.8
VEHICLES	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FURNITURE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
INTEREST DURING CONST.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	100.1	45.8	0.0	0.0	45.8	0.0	45.8	0.0	0.0	45.8	0.0	45.8
OPERATION EXPENSES												
COST OF ENERGY	256.2	273.0	273.0	271.1	294.3	293.9	308.7	307.5	306.2	321.3	321.3	338.2
MAINTENANCE COSTS	30.6	33.6	33.6	33.6	36.6	36.6	39.6	39.6	39.6	42.6	42.6	45.6
RESIDUAL VALUE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	286.8	306.6	306.6	304.7	330.9	330.5	348.3	347.1	345.8	363.9	363.9	383.8
TOTAL COST	386.8	352.3	306.6	304.7	376.7	330.5	394.1	347.1	345.8	409.7	363.9	429.6

PRESENT VALUE = 5970.4

PRESENT VALUE OF AN ALTERNATIVE
IN CONSTANT DOLLARS

	YEARS											
	13	14	15	16	17	18	19	20	21	22	23	24
INVESTMENTS												
LAND	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CONSTRUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ENGINEERING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
EQUIPMENT	0.0	0.0	156.1	0.0	45.8	0.0	302.0	0.0	100.1	91.5	0.0	45.8
VEHICLES	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FURNITURE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
INTEREST DURING CONST.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	0.0	0.0	156.1	0.0	45.8	0.0	302.0	0.0	100.1	91.5	0.0	45.8
OPERATION EXPENSES												
COST OF ENERGY	338.2	338.2	355.0	355.0	371.1	397.4	397.4	397.4	397.4	401.2	405.0	485.1
MAINTENANCE COSTS	45.6	45.6	48.6	48.6	51.6	51.6	54.6	54.6	54.6	57.6	57.6	60.6
RESIDUAL VALUE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	383.8	383.8	403.6	403.6	422.7	449.0	452.0	452.0	452.0	458.8	462.6	545.7
TOTAL COST	383.8	383.8	559.7	403.6	468.5	449.0	754.0	452.0	552.1	550.3	462.6	591.4

PRESENT VALUE OF AN ALTERNATIVE
IN CONSTANT DOLLARS

	YEARS											
	25	26	27	28	29	30	31	32	33	34	35	36
INVESTMENTS												
LAND	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CONSTRUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ENGINEERING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
EQUIPMENT	45.8	45.8	91.5	0.0	45.8	45.8	0.0	0.0	0.0	0.0	0.0	0.0
VEHICLES	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FURNITURE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
INTEREST DURING CONST.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	45.8	45.8	91.5	0.0	45.8	45.8	0.0	0.0	0.0	0.0	0.0	0.0
OPERATION EXPENSES												
COST OF ENERGY	489.6	494.1	498.0	502.5	507.0	511.5	0.0	0.0	0.0	0.0	0.0	0.0
MAINTENANCE COSTS	60.6	63.6	66.6	66.6	69.6	69.6	0.0	0.0	0.0	0.0	0.0	0.0
RESIDUAL VALUE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	550.2	557.7	564.6	569.1	576.6	581.1	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL COST	596.0	603.5	656.1	569.1	622.4	626.9	0.0	0.0	0.0	0.0	0.0	0.0

RUPERT HOUSE, 50% OIL-50% WOOD
7-MAY-84 10:44:03

COGESULT, EXPERTS-CONSEILS, MONTREAL
PAGE 1

PRESENT VALUE OF AN ALTERNATIVE
IN CONSTANT DOLLARS

	YEARS											
	1	2	3	4	5	6	7	8	9	10	11	12
INVESTMENTS												
LAND	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CONSTRUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ENGINEERING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
EQUIPMENT	100.1	45.8	0.0	0.0	45.8	0.0	45.8	0.0	0.0	45.8	0.0	45.8
VEHICLES	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FURNITURE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
INTEREST DURING CONST.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	100.1	45.8	0.0	0.0	45.8	0.0	45.8	0.0	0.0	45.8	0.0	45.8
OPERATION EXPENSES												
COST OF ENERGY	209.1	222.6	222.6	221.4	240.5	240.2	252.9	252.1	251.2	263.7	263.7	277.1
MAINTENANCE COSTS	30.6	33.6	33.6	33.6	36.6	36.6	39.6	39.6	39.6	42.6	42.6	45.6
RESIDUAL VALUE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	239.7	256.2	256.2	255.0	277.1	276.8	292.5	291.6	290.8	306.3	306.3	322.7
TOTAL COST	339.7	301.9	256.2	255.0	322.8	276.8	338.2	291.6	290.8	352.0	306.3	368.5

PRESENT VALUE = 5097.7

PRESENT VALUE OF AN ALTERNATIVE
IN CONSTANT DOLLARS

	YEARS											
	13	14	15	16	17	18	19	20	21	22	23	24
INVESTMENTS												
LAND	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CONSTRUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ENGINEERING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
EQUIPMENT	0.0	0.0	156.1	0.0	45.8	0.0	302.0	0.0	100.1	91.5	0.0	45.8
VEHICLES	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FURNITURE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
INTEREST DURING CONST.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	0.0	0.0	156.1	0.0	45.8	0.0	302.0	0.0	100.1	91.5	0.0	45.8
OPERATION EXPENSES												
COST OF ENERGY	277.1	277.1	290.7	290.7	304.3	325.8	325.8	325.8	325.8	328.3	330.8	395.6
MAINTENANCE COSTS	45.6	45.6	48.6	48.6	51.6	51.6	54.6	54.6	54.6	57.6	57.6	60.6
RESIDUAL VALUE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	322.7	322.7	339.3	339.3	355.9	377.4	380.4	380.4	380.4	385.9	388.4	456.2
TOTAL COST	322.7	322.7	495.5	339.3	401.6	377.4	682.3	380.4	480.4	477.4	388.4	501.9

PRESENT VALUE OF AN ALTERNATIVE
IN CONSTANT DOLLARS

	YEARS											
	25	26	27	28	29	30	31	32	33	34	35	36
INVESTMENTS												
LAND	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CONSTRUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ENGINEERING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
EQUIPMENT	45.8	45.8	91.5	0.0	45.8	45.8	0.0	0.0	0.0	0.0	0.0	0.0
VEHICLES	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FURNITURE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
INTEREST DURING CONST.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	45.8	45.8	91.5	0.0	45.8	45.8	0.0	0.0	0.0	0.0	0.0	0.0
OPERATION EXPENSES												
COST OF ENERGY	398.6	401.6	404.2	407.2	410.2	413.2	0.0	0.0	0.0	0.0	0.0	0.0
MAINTENANCE COSTS	60.6	63.6	66.6	66.6	69.6	69.6	0.0	0.0	0.0	0.0	0.0	0.0
RESIDUAL VALUE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	459.2	465.2	470.8	473.8	479.8	482.8	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL COST	505.0	511.0	562.3	473.8	525.6	528.6	0.0	0.0	0.0	0.0	0.0	0.0

PRESENT VALUE OF AN ALTERNATIVE
IN CONSTANT DOLLARS

	YEARS											
	1	2	3	4	5	6	7	8	9	10	11	12
INVESTMENTS												
LAND	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CONSTRUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ENGINEERING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
EQUIPMENT	100.1	45.8	0.0	0.0	45.8	0.0	45.8	0.0	0.0	45.8	0.0	45.8
VEHICLES	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FURNITURE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
INTEREST DURING CONST.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	100.1	45.8	0.0	0.0	45.8	0.0	45.8	0.0	0.0	45.8	0.0	45.8
OPERATION EXPENSES												
COST OF ENERGY	161.3	171.6	171.6	171.0	186.1	185.9	196.4	196.0	195.6	205.3	205.3	216.2
MAINTENANCE COSTS	30.6	33.6	33.6	33.6	36.6	36.6	39.6	39.6	39.6	42.6	42.6	45.6
RESIDUAL VALUE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	191.9	205.2	205.2	204.6	222.7	222.5	236.0	235.6	235.2	247.9	247.9	261.8
TOTAL COST	292.0	251.0	205.2	204.6	268.4	222.5	281.8	235.6	235.2	293.6	247.9	307.5

PRESENT VALUE = 4220.5

PRESENT VALUE OF AN ALTERNATIVE
IN CONSTANT DOLLARS

	YEARS											
	13	14	15	16	17	18	19	20	21	22	23	24
INVESTMENTS												
LAND	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CONSTRUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ENGINEERING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
EQUIPMENT	0.0	0.0	156.1	0.0	45.8	0.0	302.0	0.0	100.1	91.5	0.0	45.8
VEHICLES	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FURNITURE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
INTEREST DURING CONST.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	0.0	0.0	156.1	0.0	45.8	0.0	302.0	0.0	100.1	91.5	0.0	45.8
OPERATION EXPENSES												
COST OF ENERGY	216.2	216.2	227.1	227.1	237.3	254.0	254.0	254.0	254.0	255.3	256.6	306.2
MAINTENANCE COSTS	45.6	45.6	48.6	48.6	51.6	51.6	54.6	54.6	54.6	57.6	57.6	60.6
RESIDUAL VALUE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	261.8	261.8	275.7	275.7	288.9	305.6	308.6	308.6	308.6	312.9	314.2	366.8
TOTAL COST	261.8	261.8	431.8	275.7	334.7	305.6	610.6	308.6	408.7	404.4	314.2	412.6

PRESENT VALUE OF AN ALTERNATIVE
IN CONSTANT DOLLARS

	YEARS											
	25	26	27	28	29	30	31	32	33	34	35	36
INVESTMENTS												
LAND	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CONSTRUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ENGINEERING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
EQUIPMENT	45.8	45.8	91.5	0.0	45.8	45.8	0.0	0.0	0.0	0.0	0.0	0.0
VEHICLES	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FURNITURE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
INTEREST DURING CONST.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	45.8	45.8	91.5	0.0	45.8	45.8	0.0	0.0	0.0	0.0	0.0	0.0
OPERATION EXPENSES												
COST OF ENERGY	307.7	309.2	310.5	312.0	313.5	315.0	0.0	0.0	0.0	0.0	0.0	0.0
MAINTENANCE COSTS	60.6	63.6	66.6	66.6	69.6	69.6	0.0	0.0	0.0	0.0	0.0	0.0
RESIDUAL VALUE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	368.3	372.8	377.1	378.6	383.1	384.6	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL COST	414.1	418.6	468.6	378.6	428.9	430.4	0.0	0.0	0.0	0.0	0.0	0.0

RUPERT HOUSE, 100% WOOD
16-MAY-84

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COGESULT, EXPERTS-CONSEILS, MONTREAL
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PRESENT VALUE OF AN ALTERNATIVE
IN CONSTANT DOLLARS

	YEARS											
	1	2	3	4	5	6	7	8	9	10	11	12
INVESTMENTS												
LAND	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CONSTRUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ENGINEERING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
EQUIPMENT	100.1	21.8	0.0	0.0	21.8	0.0	21.8	0.0	0.0	21.8	0.0	21.8
VEHICLES	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FURNITURE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
INTEREST DURING CONST.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	100.1	21.8	0.0	0.0	21.8	0.0	21.8	0.0	0.0	21.8	0.0	21.8
OPERATION EXPENSES												
COST OF ENERGY	113.6	121.2	121.2	121.2	132.2	132.2	139.9	139.9	139.9	147.5	147.5	155.2
MAINTENANCE COSTS	15.3	16.8	16.8	16.8	18.3	18.3	19.8	19.8	19.8	21.3	21.3	22.8
TOTAL	128.9	138.0	138.0	138.0	150.5	150.5	159.7	159.7	159.7	168.8	168.8	178.0
TOTAL COST	229.0	159.8	138.0	138.0	172.3	150.5	181.5	159.7	159.7	190.6	168.8	199.8

PRESENT VALUE = 2180.4

PRESENT VALUE OF AN ALTERNATIVE
IN CONSTANT DOLLARS

	YEARS											
	13	14	15	16	17	18	19	20	21	22	23	24
INVESTMENTS												
LAND	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CONSTRUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ENGINEERING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
EQUIPMENT	0.0	0.0	21.8	0.0	21.8	0.0	143.6	0.0	100.1	43.5	0.0	21.8
VEHICLES	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FURNITURE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
INTEREST DURING CONST.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	0.0	0.0	21.8	0.0	21.8	0.0	143.6	0.0	100.1	43.5	0.0	21.8
OPERATION EXPENSES												
COST OF ENERGY	155.2	155.2	162.8	162.8	170.5	182.4	182.4	182.4	182.4	182.4	182.4	216.7
MAINTENANCE COSTS	22.8	22.8	24.3	24.3	25.8	25.8	27.3	27.3	27.3	28.8	28.8	30.3
TOTAL	178.0	178.0	187.1	187.1	196.3	208.2	209.7	209.7	209.7	211.2	211.2	247.0
TOTAL COST	178.0	178.0	208.9	187.1	218.1	208.2	353.2	209.7	309.7	254.7	211.2	268.8

PRESENT VALUE OF AN ALTERNATIVE
IN CONSTANT DOLLARS

	YEARS											
	25	26	27	28	29	30	31	32	33	34	35	36
INVESTMENTS												
LAND	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CONSTRUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ENGINEERING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
EQUIPMENT	21.8	21.8	43.5	0.0	21.8	21.8	0.0	0.0	0.0	0.0	0.0	0.0
VEHICLES	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FURNITURE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
INTEREST DURING CONST.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	21.8	21.8	43.5	0.0	21.8	21.8	0.0	0.0	0.0	0.0	0.0	0.0
OPERATION EXPENSES												
COST OF ENERGY	216.7	216.7	216.7	216.7	216.7	216.7	0.0	0.0	0.0	0.0	0.0	0.0
MAINTENANCE COSTS	30.3	31.8	33.3	33.3	34.8	34.8	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	247.0	248.5	250.0	250.0	251.5	251.5	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL COST	268.8	270.3	293.5	250.0	273.3	273.3	0.0	0.0	0.0	0.0	0.0	0.0

RUPERT HOUSE, 100- WOOD CHIPS
24-MAY-84 15:44:07

COGENSIM, EXPERTS-COGENICS, MONTREAL
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PRESENT VALUE OF AN ALTERNATIVE
IN CONSTANT DOLLARS

	YEARS											
	1	2	3	4	5	6	7	8	9	10	11	12
INVESTMENTS												
LAND	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CONSTRUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ENGINEERING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
EQUIPMENT	612.0	60.0	0.0	0.0	60.0	0.0	60.0	0.0	0.0	60.0	0.0	60.0
VEHICLES	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FURNITURE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
INTEREST DURING CONST.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	612.0	60.0	0.0	0.0	60.0	0.0	60.0	0.0	0.0	60.0	0.0	60.0
OPERATION EXPENSES												
COST OF ENERGY	70.5	75.2	75.2	75.2	82.1	82.1	86.9	86.9	86.9	91.6	91.6	96.3
MAINTENANCE COSTS	15.3	16.8	16.8	16.8	18.3	18.3	19.8	19.8	19.8	21.3	21.3	22.8
TOTAL	85.8	92.0	92.0	92.0	100.4	100.4	106.7	106.7	106.7	112.9	112.9	119.1
TOTAL COST	697.8	152.0	92.0	92.0	160.4	100.4	166.7	106.7	106.7	172.9	112.9	179.1

PRESENT VALUE = 2802.9

PRESENT VALUE OF AN ALTERNATIVE
IN CONSTANT DOLLARS

	YEARS											
	13	14	15	16	17	18	19	20	21	22	23	24
INVESTMENTS												
LAND	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CONSTRUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ENGINEERING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
EQUIPMENT	0.0	0.0	60.0	0.0	60.0	0.0	60.0	0.0	543.2	113.3	0.0	60.0
VEHICLES	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FURNITURE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
INTEREST DURING CONST.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	0.0	0.0	60.0	0.0	60.0	0.0	60.0	0.0	543.2	113.3	0.0	60.0
OPERATION EXPENSES												
COST OF ENERGY	96.3	96.3	101.1	101.1	105.8	113.1	113.1	113.1	113.1	113.1	113.1	134.5
MAINTENANCE COSTS	22.8	22.8	24.3	24.3	25.8	25.8	27.3	27.3	27.3	28.8	28.8	30.3
TOTAL	119.1	119.1	125.4	125.4	131.6	138.9	140.4	140.4	140.4	141.9	141.9	164.8
TOTAL COST	119.1	119.1	185.4	125.4	191.6	138.9	200.4	140.4	683.6	255.2	141.9	224.8

PRESENT VALUE OF AN ALTERNATIVE
IN CONSTANT DOLLARS

	YEARS											
	25	26	27	28	29	30	31	32	33	34	35	36
INVESTMENTS												
LAND	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CONSTRUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ENGINEERING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
EQUIPMENT	53.3	60.0	113.3	0.0	60.0	53.3	0.0	0.0	0.0	0.0	0.0	0.0
VEHICLES	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FURNITURE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
INTEREST DURING CONST.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	53.3	60.0	113.3	0.0	60.0	53.3	0.0	0.0	0.0	0.0	0.0	0.0
OPERATION EXPENSES												
COST OF ENERGY	134.5	134.5	134.5	134.5	134.5	134.5	0.0	0.0	0.0	0.0	0.0	0.0
MAINTENANCE COSTS	30.3	31.8	33.3	33.3	34.8	34.8	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	164.8	166.3	167.8	167.8	169.3	169.3	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL COST	218.0	226.3	281.0	167.8	229.3	222.5	0.0	0.0	0.0	0.0	0.0	0.0

PRESENT VALUE OF AN ALTERNATIVE
IN CONSTANT DOLLARS

	YEARS											
	1	2	3	4	5	6	7	8	9	10	11	12
INVESTMENTS												
LAND	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CONSTRUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ENGINEERING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
EQUIPMENT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
VEHICLES	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FURNITURE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
INTEREST DURING CONST.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OPERATION EXPENSES												
COST OF ENERGY	729.0	778.0	778.0	778.0	848.9	848.9	897.9	897.9	897.9	947.0	947.0	996.0
MAINTENANCE COST	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	729.0	778.0	778.0	778.0	848.9	848.9	897.9	897.9	897.9	947.0	947.0	996.0
TOTAL COST	729.0	778.0	778.0	778.0	848.9	848.9	897.9	897.9	897.9	947.0	947.0	996.0

PRESENT VALUE 13625.0

PRESENT VALUE OF AN ALTERNATIVE
IN CONSTANT DOLLARS

	YEARS											
	13	14	15	16	17	18	19	30	31	32	33	34
INVESTMENTS												
LAND	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CONSTRUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ENGINEERING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
EQUIPMENT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
VEHICLES	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FURNITURE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
INTEREST DURING CONST.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OPERATION EXPENSES												
COST OF ENERGY	996.0	996.0	1045.1	1045.1	1094.1	1170.4	1170.4	1170.4	1170.4	1170.4	1170.4	1390.8
MAINTENANCE COSTS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	996.0	996.0	1045.1	1045.1	1094.1	1170.4	1170.4	1170.4	1170.4	1170.4	1170.4	1390.8
TOTAL COST	996.0	996.0	1045.1	1045.1	1094.1	1170.4	1170.4	1170.4	1170.4	1170.4	1170.4	1390.8

PRESENT VALUE OF AN ALTERNATIVE
IN CONSTANT DOLLARS

	YEARS											
	25	26	27	28	29	30	31	32	33	34	35	36
INVESTMENTS												
LAND	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CONSTRUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ENGINEERING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
EQUIPMENT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
VEHICLES	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FURNITURE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
INTEREST DURING CONST.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OPERATION EXPENSES												
COST OF ENERGY	1390.8	1390.8	1390.8	1390.8	1390.8	1390.8	0.0	0.0	0.0	0.0	0.0	0.0
MAINTENANCE COSTS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	1390.8	1390.8	1390.8	1390.8	1390.8	1390.8	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL COST	1390.8	1390.8	1390.8	1390.8	1390.8	1390.8	0.0	0.0	0.0	0.0	0.0	0.0

EASTMAIN, 100% OIL
10-MAY-84 15:13:42 COGESULT, EXPERTS-CONSEILS, MONTREAL
PAGE 1

PRESENT VALUE OF AN ALTERNATIVE
IN CONSTANT DOLLARS

	YEARS											
	1	2	3	4	5	6	7	8	9	10	11	12
INVESTMENTS												
LAND	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CONSTRUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ENGINEERING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
EQUIPMENT	16.0	0.0	22.4	22.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
VEHICLES	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FURNITURE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
INTEREST DURING CONST.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	16.0	0.0	22.4	22.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OPERATION EXPENSES												
COST OF ENERGY	135.9	135.4	143.3	138.7	137.9	125.7	125.0	124.4	123.7	123.2	123.2	123.2
MAINTENANCE COSTS	7.1	7.1	8.0	8.4	8.4	7.9	7.9	7.9	7.9	7.9	7.9	7.9
TOTAL	143.0	142.5	151.3	147.1	146.3	133.6	132.9	132.3	131.6	131.1	131.1	131.1
TOTAL COST	159.0	142.5	173.7	169.5	146.3	133.6	132.9	132.3	131.6	131.1	131.1	131.1

PRESENT VALUE = 2271.7

PRESENT VALUE OF AN ALTERNATIVE
IN CONSTANT DOLLARS

	YEARS											
	13	14	15	16	17	18	19	20	21	22	23	24
INVESTMENTS												
LAND	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CONSTRUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ENGINEERING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
EQUIPMENT	24.0	0.0	43.2	0.0	0.0	0.0	22.4	24.0	16.0	0.0	22.4	22.4
VEHICLES	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FURNITURE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
INTEREST DURING CONST.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	24.0	0.0	43.2	0.0	0.0	0.0	22.4	24.0	16.0	0.0	22.4	22.4
OPERATION EXPENSES												
COST OF ENERGY	144.1	144.1	144.1	144.1	144.1	144.1	144.1	165.0	165.0	166.6	168.3	169.9
MAINTENANCE COSTS	9.4	9.4	9.4	9.4	9.4	9.4	9.4	10.9	10.9	10.9	10.9	10.9
TOTAL	153.5	153.5	153.5	153.5	153.5	153.5	153.5	175.9	175.9	177.5	179.2	180.8
TOTAL COST	177.5	153.5	196.7	153.5	153.5	153.5	175.9	199.9	191.9	177.5	201.6	203.2

PRESENT VALUE OF AN ALTERNATIVE
IN CONSTANT DOLLARS

	YEARS											
	25	26	27	28	29	30	31	32	33	34	35	36
INVESTMENTS												
LAND	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CONSTRUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ENGINEERING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
EQUIPMENT	0.0	24.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
VEHICLES	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FURNITURE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
INTEREST DURING CONST.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	0.0	24.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OPERATION EXPENSES												
COST OF ENERGY	171.6	195.9	197.8	199.9	201.8	203.9	0.0	0.0	0.0	0.0	0.0	0.0
MAINTENANCE COSTS	10.9	12.4	12.4	12.4	12.4	12.4	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	182.5	208.3	210.2	212.3	214.2	216.3	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL COST	182.5	232.3	210.2	212.3	214.2	216.3	0.0	0.0	0.0	0.0	0.0	0.0

EASTMAIN, 75% OIL-25% WOOD
7-MAY-84

10:46:57

COGESULT, EXPERTS-CONSEILS, MONTREAL
PAGE 1

PRESENT VALUE OF AN ALTERNATIVE
IN CONSTANT DOLLARS

	YEARS											
	1	2	3	4	5	6	7	8	9	10	11	12
INVESTMENTS												
LAND	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CONSTRUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ENGINEERING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
EQUIPMENT	69.7	0.0	42.7	42.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
VEHICLES	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FURNITURE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
INTEREST DURING CONST.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	69.7	0.0	42.7	42.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OPERATION EXPENSES												
COST OF ENERGY	113.2	112.8	119.3	115.3	114.8	105.0	104.5	104.1	103.6	103.2	103.2	103.2
MAINTENANCE COSTS	14.2	14.2	16.0	16.8	16.8	15.8	15.8	15.8	15.8	15.8	15.8	15.8
RESIDUAL VALUE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	127.4	127.0	135.3	132.1	131.6	120.8	120.3	119.9	119.4	119.0	119.0	119.0
TOTAL COST	197.0	127.0	178.0	174.8	131.6	120.8	120.3	119.9	119.4	119.0	119.0	119.0

PRESENT VALUE = 2204.0

PRESENT VALUE OF AN ALTERNATIVE
IN CONSTANT DOLLARS

	YEARS											
	13	14	15	16	17	18	19	20	21	22	23	24
INVESTMENTS												
LAND	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CONSTRUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ENGINEERING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
EQUIPMENT	45.8	0.0	43.2	0.0	0.0	0.0	42.7	45.8	69.7	0.0	42.7	42.7
VEHICLES	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FURNITURE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
INTEREST DURING CONST.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	45.8	0.0	43.2	0.0	0.0	0.0	42.7	45.8	69.7	0.0	42.7	42.7
OPERATION EXPENSES												
COST OF ENERGY	120.4	120.4	120.4	120.4	120.4	120.4	120.4	138.2	138.2	139.4	140.7	141.9
MAINTENANCE COSTS	18.8	18.8	18.8	18.8	18.8	18.8	18.8	21.8	21.8	21.8	21.8	21.8
RESIDUAL VALUE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	139.2	139.2	139.2	139.2	139.2	139.2	139.2	160.0	160.0	161.2	162.5	163.7
TOTAL COST	184.9	139.2	182.4	139.2	139.2	139.2	181.9	205.7	229.6	161.2	205.2	206.4

PRESENT VALUE OF AN ALTERNATIVE
IN CONSTANT DOLLARS

	YEARS											
	25	26	27	28	29	30	31	32	33	34	35	36
INVESTMENTS												
LAND	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CONSTRUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ENGINEERING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
EQUIPMENT	0.0	45.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
VEHICLES	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FURNITURE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
INTEREST DURING CONST.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	0.0	45.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OPERATION EXPENSES												
COST OF ENERGY	143.2	163.0	164.4	166.0	167.4	169.0	0.0	0.0	0.0	0.0	0.0	0.0
MAINTENANCE COSTS	21.8	24.8	24.8	24.8	24.8	24.8	0.0	0.0	0.0	0.0	0.0	0.0
RESIDUAL VALUE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	165.0	187.8	189.2	190.8	192.2	193.8	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL COST	165.0	233.5	189.2	190.8	192.2	193.8	0.0	0.0	0.0	0.0	0.0	0.0

PRESENT VALUE OF AN ALTERNATIVE
IN CONSTANT DOLLARS

	YEARS											
	1	2	3	4	5	6	7	8	9	10	11	12
INVESTMENTS												
LAND	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CONSTRUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ENGINEERING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
EQUIPMENT	69.7	0.0	42.7	42.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
VEHICLES	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FURNITURE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
INTEREST DURING CONST.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	69.7	0.0	42.7	42.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OPERATION EXPENSES												
COST OF ENERGY	90.5	90.3	95.9	92.7	92.3	83.8	83.4	83.2	82.8	82.6	82.6	82.6
MAINTENANCE COSTS	14.2	14.2	16.0	16.8	16.8	15.8	15.8	15.8	15.8	15.8	15.8	15.8
RESIDUAL VALUE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	104.7	104.5	111.9	109.5	109.1	99.6	99.2	99.0	98.6	98.4	98.4	98.4
TOTAL COST	174.4	104.5	154.6	152.2	109.1	99.6	99.2	99.0	98.6	98.4	98.4	98.4

PRESENT VALUE = 1870.0

PRESENT VALUE OF AN ALTERNATIVE
IN CONSTANT DOLLARS

	YEARS											
	13	14	15	16	17	18	19	20	21	22	23	24
INVESTMENTS												
LAND	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CONSTRUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ENGINEERING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
EQUIPMENT	45.8	0.0	43.2	0.0	0.0	0.0	42.7	45.8	69.7	0.0	42.7	42.7
VEHICLES	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FURNITURE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
INTEREST DURING CONST.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	45.8	0.0	43.2	0.0	0.0	0.0	42.7	45.8	69.7	0.0	42.7	42.7
OPERATION EXPENSES												
COST OF ENERGY	97.3	97.3	97.3	97.3	97.3	97.3	97.3	111.4	111.4	112.2	113.0	113.9
MAINTENANCE COSTS	18.8	18.8	18.8	18.8	18.8	18.8	18.8	21.8	21.8	21.8	21.8	21.8
RESIDUAL VALUE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	116.1	116.1	116.1	116.1	116.1	116.1	116.1	133.2	133.2	134.0	134.8	135.7
TOTAL COST	161.8	116.1	159.3	116.1	116.1	116.1	158.8	178.9	202.8	134.0	177.5	178.4

PRESENT VALUE OF AN ALTERNATIVE
IN CONSTANT DOLLARS

	YEARS											
	25	26	27	28	29	30	31	32	33	34	35	36
INVESTMENTS												
LAND	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CONSTRUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ENGINEERING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
EQUIPMENT	0.0	45.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
VEHICLES	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FURNITURE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
INTEREST DURING CONST.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	0.0	45.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OPERATION EXPENSES												
COST OF ENERGY	114.7	130.2	131.1	132.2	133.1	134.2	0.0	0.0	0.0	0.0	0.0	0.0
MAINTENANCE COSTS	21.8	24.8	24.8	24.8	24.8	24.8	0.0	0.0	0.0	0.0	0.0	0.0
RESIDUAL VALUE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	136.5	155.0	155.9	157.0	157.9	159.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL COST	136.5	200.7	155.9	157.0	157.9	159.0	0.0	0.0	0.0	0.0	0.0	0.0

EASTMAIN, 25% OIL-75% WOOD
7-MAY-84

10:48:36

CUGESULT, EXPERTS-CONSEILS, MONTREAL
PAGE 1

PRESENT VALUE OF AN ALTERNATIVE
IN CONSTANT DOLLARS

	YEARS											
	1	2	3	4	5	6	7	8	9	10	11	12
INVESTMENTS												
LAND	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CONSTRUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ENGINEERING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
EQUIPMENT	69.7	0.0	42.7	42.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
VEHICLES	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FURNITURE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
INTEREST DURING CONST.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	69.7	0.0	42.7	42.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OPERATION EXPENSES												
COST OF ENERGY	67.8	67.7	71.9	69.3	69.1	63.2	63.0	62.9	62.7	62.5	62.5	62.5
MAINTENANCE COSTS	14.2	14.2	16.0	16.8	16.8	15.8	15.8	15.8	15.8	15.8	15.8	15.8
RESIDUAL VALUE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	82.0	81.8	87.9	86.1	85.9	79.0	78.8	78.7	78.5	78.3	78.3	78.3
TOTAL COST	151.6	81.8	130.6	128.8	85.9	79.0	78.8	78.7	78.5	78.3	78.3	78.3

PRESENT VALUE = 1533.5

PRESENT VALUE OF AN ALTERNATIVE
IN CONSTANT DOLLARS

	YEARS											
	13	14	15	16	17	18	19	20	21	22	23	24
INVESTMENTS												
LAND	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CONSTRUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ENGINEERING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
EQUIPMENT	45.8	0.0	43.2	0.0	0.0	0.0	42.7	45.8	69.7	0.0	42.7	42.7
VEHICLES	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FURNITURE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
INTEREST DURING CONST.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	45.8	0.0	43.2	0.0	0.0	0.0	42.7	45.8	69.7	0.0	42.7	42.7
OPERATION EXPENSES												
COST OF ENERGY	73.6	73.6	73.6	73.6	73.6	73.6	73.6	83.9	83.9	84.3	84.7	85.1
MAINTENANCE COSTS	18.8	18.8	18.8	18.8	18.8	18.8	18.8	21.8	21.8	21.8	21.8	21.8
RESIDUAL VALUE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	92.4	92.4	92.4	92.4	92.4	92.4	92.4	105.7	105.7	106.1	106.5	106.9
TOTAL COST	138.1	92.4	135.6	92.4	92.4	92.4	135.1	151.5	175.4	106.1	149.2	149.6

PRESENT VALUE OF AN ALTERNATIVE
IN CONSTANT DOLLARS

	YEARS											
	25	26	27	28	29	30	31	32	33	34	35	36
INVESTMENTS												
LAND	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CONSTRUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ENGINEERING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
EQUIPMENT	0.0	45.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
VEHICLES	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FURNITURE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
INTEREST DURING CONST.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	0.0	45.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OPERATION EXPENSES												
COST OF ENERGY	85.6	97.3	97.7	98.3	98.8	99.3	0.0	0.0	0.0	0.0	0.0	0.0
MAINTENANCE COSTS	21.8	24.8	24.8	24.8	24.8	24.8	0.0	0.0	0.0	0.0	0.0	0.0
RESIDUAL VALUE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	107.4	122.1	122.5	123.1	123.6	124.1	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL COST	107.4	167.8	122.5	123.1	123.6	124.1	0.0	0.0	0.0	0.0	0.0	0.0

PRESENT VALUE OF AN ALTERNATIVE
IN CONSTANT DOLLARS

	YEARS											
	1	2	3	4	5	6	7	8	9	10	11	12
INVESTMENTS												
LAND	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CONSTRUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ENGINEERING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
EQUIPMENT	53.7	0.0	20.3	20.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
VEHICLES	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FURNITURE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
INTEREST DURING CONST.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	53.7	0.0	20.3	20.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OPERATION EXPENSES												
COST OF ENERGY	45.1	45.1	47.9	46.6	46.6	42.5	42.5	42.5	42.5	42.5	42.5	42.5
MAINTENANCE COSTS	7.1	7.1	8.0	8.4	8.4	7.9	7.9	7.9	7.9	7.9	7.9	7.9
TOTAL	52.2	52.2	55.9	55.0	55.0	50.4	50.4	50.4	50.4	50.4	50.4	50.4
TOTAL COST	105.9	52.2	76.2	75.3	55.0	50.4	50.4	50.4	50.4	50.4	50.4	50.4

PRESENT VALUE = 953.8

PRESENT VALUE OF AN ALTERNATIVE
IN CONSTANT DOLLARS

	YEARS											
	13	14	15	16	17	18	19	20	21	22	23	24
INVESTMENTS												
LAND	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CONSTRUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ENGINEERING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
EQUIPMENT	21.8	0.0	0.0	0.0	0.0	0.0	20.3	21.8	53.7	0.0	20.3	20.3
VEHICLES	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FURNITURE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
INTEREST DURING CONST.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	21.8	0.0	0.0	0.0	0.0	0.0	20.3	21.8	53.7	0.0	20.3	20.3
OPERATION EXPENSES												
COST OF ENERGY	49.9	49.9	49.9	49.9	49.9	49.9	49.9	57.1	57.1	57.1	57.1	57.1
MAINTENANCE COSTS	9.4	9.4	9.4	9.4	9.4	9.4	9.4	10.9	10.9	10.9	10.9	10.9
TOTAL	59.3	59.3	59.3	59.3	59.3	59.3	59.3	68.0	68.0	68.0	68.0	68.0
TOTAL COST	81.0	59.3	59.3	59.3	59.3	59.3	79.6	89.8	121.7	68.0	88.3	88.3

PRESENT VALUE OF AN ALTERNATIVE
IN CONSTANT DOLLARS

	YEARS											
	25	26	27	28	29	30	31	32	33	34	35	36
INVESTMENTS												
LAND	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CONSTRUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ENGINEERING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
EQUIPMENT	0.0	21.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
VEHICLES	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FURNITURE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
INTEREST DURING CONST.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	0.0	21.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OPERATION EXPENSES												
COST OF ENERGY	57.1	64.4	64.4	64.4	64.4	64.4	0.0	0.0	0.0	0.0	0.0	0.0
MAINTENANCE COSTS	10.9	12.4	12.4	12.4	12.4	12.4	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	68.0	76.8	76.8	76.8	76.8	76.8	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL COST	68.0	98.5	76.8	76.8	76.8	76.8	0.0	0.0	0.0	0.0	0.0	0.0

EASTMAIN, 100% WOOD CHIPS
24-MAY-84 15:41:51

PRESENT VALUE OF AN ALTERNATIVE
IN CONSTANT DOLLARS

	YEARS											
	1	2	3	4	5	6	7	8	9	10	11	12
INVESTMENTS												
LAND	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CONSTRUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ENGINEERING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
EQUIPMENT	284.0	0.0	56.0	56.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
VEHICLES	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FURNITURE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
INTEREST DURING CONST.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	284.0	0.0	56.0	56.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OPERATION EXPENSES												
COST OF ENERGY	29.3	29.3	31.2	30.3	30.3	27.6	27.6	27.6	27.6	27.6	27.6	27.6
MAINTENANCE COSTS	7.1	7.1	8.0	8.4	8.4	7.9	7.9	7.9	7.9	7.9	7.9	7.9
TOTAL	36.4	36.4	39.2	38.7	38.7	35.5	35.5	35.5	35.5	35.5	35.5	35.5
TOTAL COST	320.4	36.4	95.2	94.7	38.7	35.5	35.5	35.5	35.5	35.5	35.5	35.5

PRESENT VALUE = 1105.3

PRESENT VALUE OF AN ALTERNATIVE
IN CONSTANT DOLLARS

	YEARS											
	13	14	15	16	17	18	19	20	21	22	23	24
INVESTMENTS												
LAND	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CONSTRUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ENGINEERING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
EQUIPMENT	60.0	0.0	0.0	0.0	0.0	0.0	0.0	60.0	252.1	0.0	49.7	49.7
VEHICLES	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FURNITURE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
INTEREST DURING CONST.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	60.0	0.0	0.0	0.0	0.0	0.0	0.0	60.0	252.1	0.0	49.7	49.7
OPERATION EXPENSES												
COST OF ENERGY	32.4	32.4	32.4	32.4	32.4	32.4	32.4	37.1	37.1	37.1	37.1	37.1
MAINTENANCE COSTS	9.4	9.4	9.4	9.4	9.4	9.4	9.4	10.9	10.9	10.9	10.9	10.9
TOTAL	41.8	41.8	41.8	41.8	41.8	41.8	41.8	48.0	48.0	48.0	48.0	48.0
TOTAL COST	101.8	41.8	41.8	41.8	41.8	41.8	41.8	108.0	300.1	48.0	97.7	97.7

PRESENT VALUE OF AN ALTERNATIVE
IN CONSTANT DOLLARS

	YEARS											
	25	26	27	28	29	30	31	32	33	34	35	36
INVESTMENTS												
LAND	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CONSTRUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ENGINEERING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
EQUIPMENT	0.0	60.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
VEHICLES	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FURNITURE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
INTEREST DURING CONST.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	0.0	60.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OPERATION EXPENSES												
COST OF ENERGY	37.1	41.8	41.8	41.8	41.8	41.8	0.0	0.0	0.0	0.0	0.0	0.0
MAINTENANCE COSTS	10.9	12.4	12.4	12.4	12.4	12.4	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	48.0	54.2	54.2	54.2	54.2	54.2	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL COST	48.0	114.2	54.2	54.2	54.2	54.2	0.0	0.0	0.0	0.0	0.0	0.0

PRESENT VALUE OF AN ALTERNATIVE
IN CONSTANT DOLLARS

	YEARS											
	1	2	3	4	5	6	7	8	9	10	11	12
INVESTMENTS												
LAND	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CONSTRUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ENGINEERING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
EQUIPMENT	0.0	0.0	22.4	24.0	0.0	0.0	54.4	56.0	24.0	0.0	0.0	0.0
VEHICLES	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FURNITURE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
INTEREST DURING CONST.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	0.0	0.0	22.4	24.0	0.0	0.0	54.4	56.0	24.0	0.0	0.0	0.0
OPERATION EXPENSES												
COST OF ENERGY	277.2	276.0	296.8	316.1	314.4	313.9	280.5	245.7	266.3	264.7	264.7	264.7
MAINTENANCE COSTS	12.4	12.4	13.8	15.3	15.3	15.3	15.3	15.3	16.8	16.8	16.8	16.8
TOTAL	289.6	288.4	310.6	331.4	329.7	329.2	295.8	261.0	283.1	281.5	281.5	281.5
TOTAL COST	289.6	288.4	333.0	355.4	329.7	329.2	350.2	317.0	307.1	281.5	281.5	281.5

PRESENT VALUE = 4815.2

PRESENT VALUE OF AN ALTERNATIVE
IN CONSTANT DOLLARS

	YEARS											
	13	14	15	16	17	18	19	20	21	22	23	24
INVESTMENTS												
LAND	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CONSTRUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ENGINEERING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
EQUIPMENT	24.0	0.0	0.0	24.0	0.0	0.0	107.2	0.0	0.0	24.0	22.4	48.0
VEHICLES	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FURNITURE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
INTEREST DURING CONST.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	24.0	0.0	0.0	24.0	0.0	0.0	107.2	0.0	0.0	24.0	22.4	48.0
OPERATION EXPENSES												
COST OF ENERGY	285.5	285.5	285.5	306.3	306.3	306.3	327.8	327.8	327.8	352.1	355.6	380.6
MAINTENANCE COSTS	18.3	18.3	18.3	19.8	19.8	19.8	21.3	21.3	21.3	22.8	22.8	24.3
TOTAL	303.8	303.8	303.8	326.1	326.1	326.1	349.1	349.1	349.1	374.9	378.4	404.9
TOTAL COST	327.8	303.8	303.8	350.1	326.1	326.1	456.3	349.1	349.1	398.9	400.8	452.9

PRESENT VALUE OF AN ALTERNATIVE
IN CONSTANT DOLLARS

	YEARS											
	25	26	27	28	29	30	31	32	33	34	35	36
INVESTMENTS												
LAND	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CONSTRUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ENGINEERING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
EQUIPMENT	0.0	0.0	78.4	56.0	48.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
VEHICLES	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FURNITURE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
INTEREST DURING CONST.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	0.0	0.0	78.4	56.0	48.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OPERATION EXPENSES												
COST OF ENERGY	384.3	388.0	414.5	419.1	445.5	450.3	0.0	0.0	0.0	0.0	0.0	0.0
MAINTENANCE COSTS	24.3	24.3	25.8	25.8	27.3	27.3	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	408.6	412.3	440.3	444.9	472.8	477.6	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL COST	408.6	412.3	518.7	500.9	520.8	477.6	0.0	0.0	0.0	0.0	0.0	0.0

PRESENT VALUE OF AN ALTERNATIVE
IN CONSTANT DOLLARS

	YEARS											
	1	2	3	4	5	6	7	8	9	10	11	12
INVESTMENTS												
LAND	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CONSTRUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ENGINEERING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
EQUIPMENT	104.4	0.0	42.7	45.8	0.0	0.0	54.4	56.0	45.8	0.0	0.0	0.0
VEHICLES	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FURNITURE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
INTEREST DURING CONST.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	104.4	0.0	42.7	45.8	0.0	0.0	54.4	56.0	45.8	0.0	0.0	0.0
OPERATION EXPENSES												
COST OF ENERGY	233.5	232.6	249.5	266.3	265.0	264.6	236.4	207.9	224.5	223.4	223.4	223.4
MAINTENANCE COSTS	24.8	24.8	27.6	30.6	30.6	30.6	30.6	30.6	33.6	33.6	33.6	33.6
RESIDUAL VALUE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	258.3	257.4	277.1	296.9	295.6	295.2	267.0	238.5	258.1	257.0	257.0	257.0
TOTAL COST	362.7	257.4	319.8	342.7	295.6	295.2	321.4	294.5	303.9	257.0	257.0	257.0

PRESENT VALUE = 4655.3

PRESENT VALUE OF AN ALTERNATIVE
IN CONSTANT DOLLARS

	YEARS											
	13	14	15	16	17	18	19	20	21	22	23	24
INVESTMENTS												
LAND	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CONSTRUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ENGINEERING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
EQUIPMENT	45.8	0.0	0.0	45.8	0.0	0.0	204.4	0.0	104.4	45.8	42.7	91.5
VEHICLES	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FURNITURE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
INTEREST DURING CONST.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	45.8	0.0	0.0	45.8	0.0	0.0	204.4	0.0	104.4	45.8	42.7	91.5
OPERATION EXPENSES												
COST OF ENERGY	241.3	241.3	241.3	259.2	259.2	259.2	277.2	277.2	277.2	297.0	299.7	320.8
MAINTENANCE COSTS	36.6	36.6	36.6	39.6	39.6	39.6	42.6	42.6	42.6	45.6	45.6	48.6
RESIDUAL VALUE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	277.9	277.9	277.9	298.8	298.8	298.8	319.8	319.8	319.8	342.6	345.3	369.4
TOTAL COST	323.6	277.9	277.9	344.5	298.8	298.8	524.1	319.8	424.2	388.4	388.0	460.9

PRESENT VALUE OF AN ALTERNATIVE
IN CONSTANT DOLLARS

	YEARS											
	25	26	27	28	29	30	31	32	33	34	35	36
INVESTMENTS												
LAND	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CONSTRUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ENGINEERING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
EQUIPMENT	0.0	0.0	100.2	56.0	91.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
VEHICLES	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FURNITURE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
INTEREST DURING CONST.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	0.0	0.0	100.2	56.0	91.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OPERATION EXPENSES												
COST OF ENERGY	323.6	326.4	348.0	351.4	373.6	377.2	0.0	0.0	0.0	0.0	0.0	0.0
MAINTENANCE COSTS	48.6	48.6	51.6	51.6	54.6	54.6	0.0	0.0	0.0	0.0	0.0	0.0
RESIDUAL VALUE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	372.2	375.0	399.6	403.0	428.2	431.8	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL COST	372.2	375.0	499.8	459.0	519.7	431.8	0.0	0.0	0.0	0.0	0.0	0.0

PRESENT VALUE OF AN ALTERNATIVE
IN CONSTANT DOLLARS

	YEARS											
	1	2	3	4	5	6	7	8	9	10	11	12
INVESTMENTS												
LAND	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CONSTRUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ENGINEERING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
EQUIPMENT	104.4	0.0	42.7	45.8	0.0	0.0	54.4	56.0	45.8	0.0	0.0	0.0
VEHICLES	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FURNITURE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
INTEREST DURING CONST.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	104.4	0.0	42.7	45.8	0.0	0.0	54.4	56.0	45.8	0.0	0.0	0.0
OPERATION EXPENSES												
COST OF ENERGY	189.8	189.2	202.9	216.6	215.7	215.5	192.5	169.5	183.4	182.6	182.6	182.6
MAINTENANCE COSTS	24.8	24.8	27.6	30.6	30.6	30.6	30.6	30.6	33.6	33.6	33.6	33.6
RESIDUAL VALUE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	214.6	214.0	230.5	247.2	246.3	246.1	223.1	200.1	217.0	216.2	216.2	216.2
TOTAL COST	319.0	214.0	273.2	292.9	246.3	246.1	277.5	256.1	262.7	216.2	216.2	216.2

PRESENT VALUE = 3978.5

PRESENT VALUE OF AN ALTERNATIVE
IN CONSTANT DOLLARS

	YEARS											
	13	14	15	16	17	18	19	20	21	22	23	24
INVESTMENTS												
LAND	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CONSTRUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ENGINEERING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
EQUIPMENT	45.8	0.0	0.0	45.8	0.0	0.0	204.4	0.0	104.4	45.8	42.7	91.5
VEHICLES	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FURNITURE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
INTEREST DURING CONST.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	45.8	0.0	0.0	45.8	0.0	0.0	204.4	0.0	104.4	45.8	42.7	91.5
OPERATION EXPENSES												
COST OF ENERGY	197.0	197.0	197.0	211.5	211.5	211.5	225.9	225.9	225.9	242.6	244.4	260.9
MAINTENANCE COSTS	36.6	36.6	36.6	39.6	39.6	39.6	42.6	42.6	42.6	45.6	45.6	48.6
RESIDUAL VALUE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	233.6	233.6	233.6	251.1	251.1	251.1	268.5	268.5	268.5	288.2	290.0	309.5
TOTAL COST	279.4	233.6	233.6	296.8	251.1	251.1	472.8	268.5	372.9	334.0	332.7	401.0

PRESENT VALUE OF AN ALTERNATIVE
IN CONSTANT DOLLARS

	YEARS											
	25	26	27	28	29	30	31	32	33	34	35	36
INVESTMENTS												
LAND	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CONSTRUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ENGINEERING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
EQUIPMENT	0.0	0.0	100.2	56.0	91.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
VEHICLES	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FURNITURE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
INTEREST DURING CONST.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	0.0	0.0	100.2	56.0	91.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OPERATION EXPENSES												
COST OF ENERGY	262.8	264.6	281.6	283.8	301.1	303.4	0.0	0.0	0.0	0.0	0.0	0.0
MAINTENANCE COSTS	48.6	48.6	51.6	51.6	54.6	54.6	0.0	0.0	0.0	0.0	0.0	0.0
RESIDUAL VALUE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	311.4	313.2	333.2	335.4	355.7	358.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL COST	311.4	313.2	433.3	391.4	447.2	358.0	0.0	0.0	0.0	0.0	0.0	0.0

PRESENT VALUE OF AN ALTERNATIVE
IN CONSTANT DOLLARS

	YEARS											
	1	2	3	4	5	6	7	8	9	10	11	12
INVESTMENTS												
LAND	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CONSTRUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ENGINEERING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
EQUIPMENT	104.4	0.0	42.7	45.8	0.0	0.0	54.4	56.0	45.8	0.0	0.0	0.0
VEHICLES	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FURNITURE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
INTEREST DURING CONST.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	104.4	0.0	42.7	45.8	0.0	0.0	54.4	56.0	45.8	0.0	0.0	0.0
OPERATION EXPENSES												
COST OF ENERGY	145.3	145.0	155.6	166.8	166.3	166.2	149.1	131.1	141.7	141.3	141.3	141.3
MAINTENANCE COSTS	24.8	24.8	27.6	30.6	30.6	30.6	30.6	30.6	33.6	33.6	33.6	33.6
RESIDUAL VALUE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	170.1	169.8	183.2	197.4	196.9	196.8	179.7	161.7	175.3	174.9	174.9	174.9
TOTAL COST	274.5	169.8	225.9	243.1	196.9	196.8	234.1	217.7	221.0	174.9	174.9	174.9

PRESENT VALUE = 3299.0

PRESENT VALUE OF AN ALTERNATIVE
IN CONSTANT DOLLARS

	YEARS											
	13	14	15	16	17	18	19	20	21	22	23	24
INVESTMENTS												
LAND	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CONSTRUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ENGINEERING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
EQUIPMENT	45.8	0.0	0.0	45.8	0.0	0.0	204.4	0.0	104.4	45.8	42.7	91.5
VEHICLES	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FURNITURE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
INTEREST DURING CONST.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	45.8	0.0	0.0	45.8	0.0	0.0	204.4	0.0	104.4	45.8	42.7	91.5
OPERATION EXPENSES												
COST OF ENERGY	152.8	152.8	152.8	164.3	164.3	164.3	175.2	175.2	175.2	187.7	188.6	200.4
MAINTENANCE COSTS	36.6	36.6	36.6	39.6	39.6	39.6	42.6	42.6	42.6	45.6	45.6	48.6
RESIDUAL VALUE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	189.4	189.4	189.4	203.9	203.9	203.9	217.8	217.8	217.8	233.3	234.2	249.0
TOTAL COST	235.1	189.4	189.4	249.7	203.9	203.9	422.1	217.8	322.2	279.0	276.9	340.5

PRESENT VALUE OF AN ALTERNATIVE
IN CONSTANT DOLLARS

	YEARS											
	25	26	27	28	29	30	31	32	33	34	35	36
INVESTMENTS												
LAND	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CONSTRUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ENGINEERING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
EQUIPMENT	0.0	0.0	100.2	56.0	91.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
VEHICLES	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FURNITURE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
INTEREST DURING CONST.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	0.0	0.0	100.2	56.0	91.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OPERATION EXPENSES												
COST OF ENERGY	201.3	202.3	215.1	216.2	229.2	230.4	0.0	0.0	0.0	0.0	0.0	0.0
MAINTENANCE COSTS	48.6	48.6	51.6	51.6	54.6	54.6	0.0	0.0	0.0	0.0	0.0	0.0
RESIDUAL VALUE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	249.9	250.9	266.7	267.8	283.8	285.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL COST	249.9	250.9	366.8	323.8	375.3	285.0	0.0	0.0	0.0	0.0	0.0	0.0

PRESENT VALUE OF AN ALTERNATIVE
IN CONSTANT DOLLARS

	YEARS											
	13	14	15	16	17	18	19	20	21	22	23	24
INVESTMENTS												
LAND	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CONSTRUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ENGINEERING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
EQUIPMENT	45.8	0.0	0.0	45.8	0.0	0.0	204.4	0.0	104.4	45.8	42.7	91.5
VEHICLES	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FURNITURE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
INTEREST DURING CONST.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	45.8	0.0	0.0	45.8	0.0	0.0	204.4	0.0	104.4	45.8	42.7	91.5
OPERATION EXPENSES												
COST OF ENERGY	152.8	152.8	152.8	164.3	164.3	164.3	175.2	175.2	175.2	187.7	188.6	200.4
MAINTENANCE COSTS	36.6	36.6	36.6	39.6	39.6	39.6	42.6	42.6	42.6	45.6	45.6	48.6
RESIDUAL VALUE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	189.4	189.4	189.4	203.9	203.9	203.9	217.8	217.8	217.8	233.3	234.2	249.0
TOTAL COST	235.1	189.4	189.4	249.7	203.9	203.9	422.1	217.8	322.2	279.0	276.9	340.5

PRESENT VALUE OF AN ALTERNATIVE
IN CONSTANT DOLLARS

	YEARS											
	25	26	27	28	29	30	31	32	33	34	35	36
INVESTMENTS												
LAND	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CONSTRUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ENGINEERING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
EQUIPMENT	0.0	0.0	100.2	56.0	91.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
VEHICLES	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FURNITURE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
INTEREST DURING CONST.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	0.0	0.0	100.2	56.0	91.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OPERATION EXPENSES												
COST OF ENERGY	201.3	202.3	215.1	216.2	229.2	230.4	0.0	0.0	0.0	0.0	0.0	0.0
MAINTENANCE COSTS	48.6	48.6	51.6	51.6	54.6	54.6	0.0	0.0	0.0	0.0	0.0	0.0
RESIDUAL VALUE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	249.9	250.9	266.7	267.8	283.8	285.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL COST	249.9	250.9	366.8	323.8	375.3	285.0	0.0	0.0	0.0	0.0	0.0	0.0

PRESENT VALUE OF AN ALTERNATIVE
IN CONSTANT DOLLARS

	YEARS											
	1	2	3	4	5	6	7	8	9	10	11	12
INVESTMENTS												
LAND	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CONSTRUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ENGINEERING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
EQUIPMENT	104.4	0.0	20.3	21.8	0.0	0.0	0.0	0.0	21.8	0.0	0.0	0.0
VEHICLES	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FURNITURE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
INTEREST DURING CONST.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	104.4	0.0	20.3	21.8	0.0	0.0	0.0	0.0	21.8	0.0	0.0	0.0
OPERATION EXPENSES												
COST OF ENERGY	101.5	101.5	109.0	117.1	117.1	117.1	105.0	92.6	100.6	100.6	100.6	100.6
MAINTENANCE COSTS	12.4	12.4	13.8	15.3	15.3	15.3	15.3	15.3	16.8	16.8	16.8	16.8
TOTAL	113.9	113.9	122.8	132.4	132.4	132.4	120.3	107.9	117.4	117.4	117.4	117.4
TOTAL COST	218.3	113.9	143.1	154.1	132.4	132.4	120.3	107.9	139.2	117.4	117.4	117.4

PRESENT VALUE = 2124.3

PRESENT VALUE OF AN ALTERNATIVE
IN CONSTANT DOLLARS

	YEARS											
	13	14	15	16	17	18	19	20	21	22	23	24
INVESTMENTS												
LAND	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CONSTRUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ENGINEERING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
EQUIPMENT	21.8	0.0	0.0	21.8	0.0	0.0	7.0	97.2	0.0	104.4	21.8	20.3
VEHICLES	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FURNITURE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
INTEREST DURING CONST.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	21.8	0.0	0.0	21.8	0.0	0.0	7.0	97.2	0.0	104.4	21.8	20.3
OPERATION EXPENSES												
COST OF ENERGY	108.6	108.6	108.6	116.6	116.6	116.6	124.5	124.5	124.5	132.6	132.6	140.5
MAINTENANCE COSTS	18.3	18.3	18.3	19.8	19.8	19.8	21.3	21.3	21.3	22.8	22.8	24.3
TOTAL	126.9	126.9	126.9	136.4	136.4	136.4	145.8	145.8	145.8	155.4	155.4	164.8
TOTAL COST	148.6	126.9	126.9	158.2	136.4	136.4	152.8	243.0	145.8	259.8	177.1	185.1

PRESENT VALUE OF AN ALTERNATIVE
IN CONSTANT DOLLARS

YEARS

	25	26	27	28	29	30	31	32	33	34	35	36
INVESTMENTS												
LAND	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CONSTRUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ENGINEERING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
EQUIPMENT	43.5	0.0	0.0	21.8	0.0	43.5	0.0	0.0	0.0	0.0	0.0	0.0
VEHICLES	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FURNITURE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
INTEREST DURING CONST.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	43.5	0.0	0.0	21.8	0.0	43.5	0.0	0.0	0.0	0.0	0.0	0.0
OPERATION EXPENSES												
COST OF ENERGY	140.5	140.5	148.6	148.6	156.5	156.5	0.0	0.0	0.0	0.0	0.0	0.0
MAINTENANCE COSTS	24.3	24.3	25.8	25.8	27.3	27.3	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	164.8	164.8	174.4	174.4	183.8	183.8	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL COST	208.3	164.8	174.4	196.1	183.8	227.3	0.0	0.0	0.0	0.0	0.0	0.0

PRESENT VALUE OF AN ALTERNATIVE
IN CONSTANT DOLLARS

	YEARS											
	1	2	3	4	5	6	7	8	9	10	11	12
INVESTMENTS												
LAND	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CONSTRUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ENGINEERING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
EQUIPMENT	496.0	0.0	56.0	60.0	0.0	0.0	0.0	0.0	60.0	0.0	0.0	0.0
VEHICLES	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FURNITURE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
INTEREST DURING CONST.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	496.0	0.0	56.0	60.0	0.0	0.0	0.0	0.0	60.0	0.0	0.0	0.0
OPERATION EXPENSES												
COST OF ENERGY	60.2	60.2	64.7	69.5	69.5	69.5	62.3	54.9	59.7	59.7	59.7	59.7
MAINTENANCE COSTS	12.4	12.4	13.8	15.3	15.3	15.3	15.3	15.3	16.8	16.8	16.8	16.8
TOTAL	72.6	72.6	78.5	84.8	84.8	84.8	77.6	70.2	76.5	76.5	76.5	76.5
TOTAL COST	568.6	72.6	134.5	144.8	84.8	84.8	77.6	70.2	136.5	76.5	76.5	76.5

PRESENT VALUE = 2119.8

PRESENT VALUE OF AN ALTERNATIVE
IN CONSTANT DOLLARS

	YEARS											
	13	14	15	16	17	18	19	20	21	22	23	24
INVESTMENTS												
LAND	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CONSTRUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ENGINEERING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
EQUIPMENT	60.0	0.0	0.0	60.0	0.0	0.0	60.0	0.0	440.2	60.0	49.7	113.3
VEHICLES	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FURNITURE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
INTEREST DURING CONST.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	60.0	0.0	0.0	60.0	0.0	0.0	60.0	0.0	440.2	60.0	49.7	113.3
OPERATION EXPENSES												
COST OF ENERGY	64.4	64.4	64.4	69.2	69.2	69.2	73.9	73.9	73.9	78.7	78.7	83.4
MAINTENANCE COSTS	18.3	18.3	18.3	19.8	19.8	19.8	21.3	21.3	21.3	22.8	22.8	24.4
TOTAL	82.7	82.7	82.7	89.0	89.0	89.0	95.2	95.2	95.2	101.5	101.5	107.7
TOTAL COST	142.7	82.7	82.7	149.0	89.0	89.0	155.2	95.2	535.4	161.5	151.2	221.0

PRESENT VALUE OF AN ALTERNATIVE
IN CONSTANT DOLLARS

	YEARS											
	25	26	27	28	29	30	31	32	33	34	35	36
INVESTMENTS												
LAND	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CONSTRUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ENGINEERING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
EQUIPMENT	0.0	0.0	60.0	0.0	113.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
VEHICLES	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FURNITURE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
INTEREST DURING CONST.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	0.0	0.0	60.0	0.0	113.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OPERATION EXPENSES												
COST OF ENERGY	83.4	83.4	88.2	88.2	92.9	92.9	0.0	0.0	0.0	0.0	0.0	0.0
MAINTENANCE COSTS	24.3	24.3	25.8	25.8	27.3	27.3	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	107.7	107.7	114.0	114.0	120.2	120.2	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL COST	107.7	107.7	174.0	114.0	233.5	120.2	0.0	0.0	0.0	0.0	0.0	0.0

POOR

QUALITY

ORIGINAL